



UGANDA PROTECTORATE

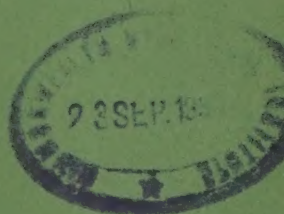
ANNUAL REPORT
OF THE
**DEPARTMENT OF
AGRICULTURE**

FOR THE PERIOD

1st April, 1947–31st March, 1948

PART II—EXPERIMENTAL

PRICE: THREE SHILLINGS



Published by Command of His Excellency the Governor

ENTEBBE
PRINTED BY THE GOVERNMENT PRINTER, UGANDA
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INTRODUCTION

It was possible during the year to effect a replacement for the post of Senior Chemist and in consequence, the important and fundamental research for which the section of Agricultural Chemistry is responsible was resumed. The posts of Chemist, Senior Plant Pathologist and Senior Economic Botanist have not yet been filled, but the return of the Senior Botanist from leave and the appointment of a Botanist strengthened the Botanical Section. The Empire Cotton Growing Corporation continued to make available the services of Mr. H. L. Manning and on the return of the Senior Botanist he concentrated on cotton botany. The thanks of the Department are due to the Corporation for this continued assistance.

Co-ordination of agricultural research has been improved by the setting up of an Experimental Committee on which all sections of the Laboratory Division are represented. All experimental programmes are now referred to this Committee annually for review in the light of progress made and the requirements of the Field Division. In addition to co-ordinating the work of the various sections of the Laboratory Division more closely, this committee provides a useful link between the field and the laboratory which it is hoped will be strengthened as time goes on.

This is the last Annual Report—Experimental which will be published. In future, the Annual Report of the Department will be published in one part which will include a summary of all experimental work, details of which will be published separately from time to time in the form of departmental bulletins which will be available on request.

T. Y. WATSON,
Acting Director of Agriculture.

REPORT OF THE SENIOR ENTOMOLOGIST

Advisory Work

Visits were paid to Toro and Bugishu coffee growing areas, to the Serere Farm for cotton work, to Bunyoro tobacco nurseries, and to the Ankole-Ruanda border where there was an outbreak of grasshoppers. Plantations were visited in Buganda.

2. Among the specimens received for identification were:

Alcides leucogrammus Er. (Coleop. Curculionidae) making galls on young beans;

Coccotrypes tanganus Eggers (Coleop. Scolitidae) eating buttons;

Podagricra sp. (Coleop. Halticidae) flea beetles on *Urena lobata*;

Thanoclerus buqueti Lef. (Coleop. Cleridae) predator of the tobacco beetle, *Lasioderma*;

Heterodera marioni (Cornu) Goodey (Nematoda) making stem galls on *Urena*.

3. The reference collection now number 7,541 species. Most of these have been determined by the Commonwealth Institute of Entomology, to whom we continue to be indebted for this valuable assistance.

4. Inspection and fumigation of plants for export has been mainly concerned with seeds, on behalf of the Conservator of Forests. One package of imported material was received for examination. A revision of the legislation relative to plant importation has been submitted to Government.

5. The course of lectures on economic entomology to the Agricultural Diploma students of Makerere College was given by the Entomologist.

6. There has been a welcome increase in the number of scientific visitors during the year including representatives of Institutions in Great Britain, Holland, Sweden, the Belgian Congo and the United States of America. Requests for specimens from workers abroad have been met as far as possible.

Locusts and Grasshoppers

7. There were no locust swarms in the Protectorate during the year. This would appear to be the first year completely free since migratory locusts arrived in May, 1929, though activity during the past three years has been on a greatly reduced scale. Developments in Tanganyika, where the Red Locust spread beyond the outbreak area, and in French West Africa, where the migratory locust showed similar tendencies, led to the augmentation of our locust scouting system by the employment of special scouts for certain uninhabited areas as a precautionary measure.

8. In July, ambulant swarms of a grasshopper *Faureia milanjica* Karsch appeared in the valley of the Kagera River on the border with Tanganyika and Ruanda. It was considered locally that many years had passed, one estimate being twenty, since the last occurrence of swarms. Bands of hoppers developed during November and December, many being destroyed by organised beating on the initiative of the local chiefs.

Benzene hexachloride—maize meal bait was sent to the area and is reported to have been effective. Young flying swarms did some damage to *eleusine* millet in January, but did not attack bananas or sweet potatoes.

9. Grasshoppers of the genera *Catantops*, *Oedalus*, *Trilophidia* and *Zonocerus* did some damage to young *eleusine* millet in the Eastern Province.

Cotton Pests

10. Work was restricted to the collection of data on cotton pest populations at Kawanda and Serere. Much of this data, especially that for *Lygus*, was required by the Botanical Section and is dealt with in their report.

11. *Lygus*.—At Kawanda, *Lygus* was rather less numerous than in the previous season, although figures for the leaf damage index were similar. The average number of *Lygus vosseleri* per one hundred sweeps taken on plots of May and July sown cotton is given below in Table I.

TABLE I
LYGUS ON COTTON—AVERAGE PER 100 SWEEPS

Date	MAY SOWN		JULY SOWN	
	Adults	Total	Adults	Total
6th September ...	3.6	7.0	...	...
29th September ...	2.6	4.0	...	...
17th October ...	1.0	2.6	...	...
27th October ...	0.0	2.2	0.7	1.5
14th November ...	0.0	0.2	0.8	0.8
28th November ...	...	...	0.3	1.3

The following values for the leaf damage index were obtained on four May sown plots, at 98 days from sowing, and suggest a relation between *Lygus* damage and plant vigour, since the size of the plants decreased with increased period of continuous cultivation of the soil:—

land newly opened from grass fallow	...	...	...	3.4
land in fourth year of cultivation	...	...	...	3.2
land under continuous cultivation for many years—				
(a) planted 14. v. followed by dry weather	...	...	...	1.8
(b) planted 28. v. weather more favourable	...	...	...	2.3

At Serere, the *Lygus* population was higher than at Kawanda and in August some plots reached 7 adults per hundred sweeps. The average leaf damage index was in the neighbourhood of 4.

12. *Helopeltis*.—There was a widespread increase in the number of *Helopeltis* observed, and reports of damage were received. Such reports were local.

13. *Dysdercus*.—Stainer populations were measured on May sown cotton at Kawanda. The peak was in December as compared with February the previous season, but this coincided with maximum boll opening, which was earlier than usual. The earliness of the season was reflected in the reduced staining of the crop. Percentage of stained locules obtained by examination of green bolls is given in Table II.

TABLE II
PERCENTAGE STAINED LOCULES IN MATURE GREEN BOLLS

Month of Examination			May sown	June sown	July sown
September	...	...	25	...	...
October	...	...	18	...	...
November	...	...	13	15	6
December	...	...	22	21	8
January	...	...	33	37	15

The actual number of stainers on the May plots averaged 600 per acre in September and October, 1,200 in November and 3,200 in December. Comparison of stainer population and proportion of stained cotton in the crop for three May sown plots is as follows:—

Plot	Mean Stainers per acre (November to December)	Yield	Stained
		lbs./acre	%
I. ...	1,620	961	17
II. ...	4,509	812	23
III. ...	1,718	1,245	15

Dysdercus nigrofasciatus provided 94 per cent of all adult stainers collected at Kawanda. *D. cardinalis* gave 4 per cent and *D. fasciatus* 2 per cent. Nymphs were present in cotton from October.

14. *Bollworms*.—Damage by bollworms was generally less than in 1946. Owing to the shorter season, the build-up was observed only on May sown cotton. The percentage of locules damaged by bollworms is given in Table III.

TABLE III
PERCENTAGE BOLLWORM DAMAGE LOCULES IN GREEN BOLLS

Month of Examination			May sown	June sown	July sown
September	...	...	4.5	...	...
October	...	...	3.7	...	...
November	...	...	3.5	2.2	0.5
December	...	...	17.5	7.4	0.7
January	...	...	17.9	7.7	3.5

To obtain some picture of the bollworm population, 25 plants were selected at random at half-monthly intervals in a May sown block and examined carefully. The results expressed as bollworms per acre for the three species are given in Table IV.

TABLE IV
BOLLWORM POPULATIONS PER ACRE

Month		<i>Platyedra</i>	<i>Earias</i>	<i>Argyroplote</i>
September	1	...	...	...
	2	...	2,900	580
October	1	...	1,160	...
	2	...	1,740	580
November	1	...	580	580 ^{1/2}
	2	...	580	580
December	1	580	580	...
	2	5,220	...	6,960
January	1	1,740	...	1,160
	2	...	...	...

Coffee Pests

15. There was no major outbreak of coffee pests during the year. Investigations carried out by the Entomologist are being published separately.

Tobacco Pests

16. A reduction in the tobacco crop in Bunyoro district in 1947 is attributed to the unusual prevalence of Root-knot Eelworm, *Heterodera marioni* in the seed beds. This led to a shortage of seedlings in a number of areas. A study of conditions in seed beds is being made this season, together with such other points as the eelworm tolerance of local crops, and common weeds as may have a bearing on rotations, fallow and similar farming practices on tobacco land.

Food Crop Pests

17. The Army Worm *Laphygma exempta* appeared in considerable numbers during late February and early March throughout a strip of country consisting of northern Busoga, Teso, southern Lango and northern Bunyoro, and in an isolated area in Ankole. From specimens received, there appears to have been a considerable degree of uniformity in the time of the outbreak. Damage was done to grain crops, particularly *eleusine* millet, and replanting was necessary in Lango.

Grain Storage

18. Inert dusts, especially diatomite, have not given completely satisfactory results in trials carried out by Agricultural Officers. Investigation of some of the failures reported has shown that there is some misconception of the powers of inert dusts. They may be expected to prevent the infestation of clean dry grain, but not to disinfest grain already attacked by weevils, or to continue to protect grain which has been allowed to get damp. Even so, the presence of diatomite in weevily maize tends to delay the development of mustiness, which leads to the grain becoming useless for food.

19. Benzene hexachloride has been tried out for the protection of seed maize with good results. Initially the maize had 1 per cent of weevil damaged grains. Bags were hand mixed with "Gammexane D.034" a dust containing 0.5 per cent gamma isomer on gypsum and china clay, at rates of 8, 4, 2 and 1 ounce per bag of 200 lbs. After six months in the Kawanda seed store, the untreated controls averaged 91 per cent of damaged grains and a germination of 28 per cent with weak shoots and much mould. All the treated bags were free from weevils. The one ounce treatment had to be discarded owing to a heavy infestation of rats. The treatment with 2 oz. per bag, equivalent to 3 parts per million of gamma isomer, had 1 per cent of damaged grain and a germination of 68 per cent, with strong shoots and no moulds.

Termites

20. The first results of a trial of DDT and BHC-treated timber for resistance to termites are given in a note for the East African Agricultural Journal (in the press). After 17 months' exposure, formulations of DDT

(5 per cent) and BHC (5 and 1 per cent crude) gave virtually complete protection to the normally termite-susceptible timber *Maesopsis eminii*. The graveyard has been reassembled with fresh control slabs for further observation. Further trials are now in progress with farm fencing poles, etc., with a view to obtaining costs and data on treatment of larger timber.

21. The effect is being studied of applications of benzene hexachloride to soil with a view to driving away termites. It is believed that ground living termites are harmful to soil fertility in certain areas in that they remove vegetable matter from the soil before it can be incorporated as humus, particularly in the case of natural and artificial mulches and farm-yard manure which has not been composted before spreading. "Agrocide 2" dust at 1 pound per 25 square yards, as suggested for wire-worm control, and at double this rate has been applied to beds heavily infested with *Termes badius* and *Pseudacanthotermes spiniger*. Early results suggest that surface applications with light raking are not effective, but that some repellent action is obtained from the larger dose when well dug in.

Publications

- DARLING, H. S., 1947.—Report of the Entomologist. *Dept. Agric. Uganda, Ann. Rept. II*: 16-30.
 HARRIS, W. V., 1947.—The Banana Borer. *East Afr. Agr. J.* 13: 15-18.
 HARRIS, W. V., 1948.—Termites of the Uganda Protectorate. *Proc. R. Ent. Soc. Lond.*
 MICHELMORE, A. P. G., 1947.—A Popular Misconception regarding Humidity. *J. Ecology* 34: 107-110.

W. V. HARRIS,
Senior Entomologist.

REPORT OF THE SENIOR CHEMIST

I arrived in Uganda at the end of April to take up my appointment in place of Dr. W. S. Martin, who had left on retirement in the previous December.

Soil Structure

Work on crumb structure to which my predecessor had devoted considerable attention was continued.

SERERE FERTILITY EXPERIMENT.

Three of the five cycles were sampled, a total of 270 plots; the results analysed by Mr. Kerkham, were in accord with previous findings and are summarised below (Table 2).

The different periods of cropping of the cycles up to the time of sampling are summarised in the following table.

TABLE I
CROPPING HISTORY (C—CROP, R—REST)

Rotation			CYCLE I			CYCLE II			CYCLE III		
			4 : 1	3 : 2	2 : 3	4 : 1	3 : 2	2 : 3	4 : 1	3 : 2	2 : 3
1936	...	...	C	C	C	R	R	R	R	R	R
1937	...	...	C	C	C	C	C	C	C	C	C
1938	...	...	C	C	R	C	C	C	C	C	C
1939	...	...	C	R	R	C	C	R	C	C	C
1940	...	...	R	R	R	C	R	R	C	C	R
1941	...	...	C	C	C	R	R	R	C	R	R
1942	...	...	C	C	C	C	C	C	R	R	R
1943	...	...	C	C	R	C	C	C	C	C	C
1944	...	...	C	R	R	C	C	R	C	C	C
1945	...	...	R	R	R	C	R	R	C	C	R
1946	...	...	C	C	C	R	R	R	C	R	R
1947	...	...	C	C	C	C	C	C	R	R	R
% crumb average of 30 plots in each case			20.3	22.0	24.3	19.1	21.8	24.4	17.7	21.6	26.1

NOTE.—Samples were taken before the 1947 cropping period had begun.

The % crumb figures in the above table are presented in this form for convenience, but it is not statistically permissible to compare the different cycles with each other; Table 2 gives the statistical analysis within each cycle.

TABLE 2A
EFFECT OF DIFFERENT PERIODS OF REST

Cropping Ratio	PERCENTAGE CRUMB		
	Cycle I	Cycle II	Cycle III
4 : 1	20.3	19.1	17.7
3 : 2	22.0	21.8	21.6
2 : 3	24.3	24.4	26.1
Significance	P > 0.05	P > 0.01	P > 0.001

TABLE 2B
EFFECT OF KRAAL MANURE

Manure applied		Cycle I 1942	Cycle II 1943	Cycle III 1944
No Manure	...	22.2	22.7	22.9
2½ tons	...	22.2	20.4	22.3
5 tons	...	22.3	22.1	20.2
Significance	...		NONE	

TABLE 2C
EFFECT OF COVER CROPS IN CYCLE I

		ROTATION			Mean
		4 : 1	3 : 2	2 : 3	
Natural Regeneration	...	18.2	24.8	30.3	24.4
<i>Cynodon</i>	...	21.6	24.7	24.5	23.6
<i>Mucuna</i> (slashed)	...	21.4	24.1	22.0	22.5
<i>Cynodon</i> (grazed)	...	15.1	16.0	27.8	19.6
<i>Mucuna</i> (dug in)	...	25.2	20.5	17.2	21.0
MEAN	...	20.3	22.0	24.3	

The effect of natural regeneration (mainly grasses) and the two *Cynodon* treatments is higher with the longer resting period; in the case of the green manure treatments this is not so. The differential response of grasses and green manures to cropping ratio is significant ($P > 0.01$).

The above findings are in accord with those previously reported, including the lack of effect of kraal manure upon percentage crumb; it is as well to point out that four, three and two years have elapsed in Cycles I, II and III respectively since manure was applied.

The percentages crumb are of a much lower order than those previously reported. This may be due to different operators. Preliminary work on this point during the year has shown that this is a factor of major importance and also that day to day variations by the same operator are considerable. In the case of the above highly replicated experiment such errors are compensated for but it is clear that a careful definition is necessary of the method to be used in determining percentage crumbs before the method can be of full value in diagnostic work and before results from different soil types and different countries can be satisfactorily compared.

SERERE PADDocks.

The grazing experiment was sampled and examined. The percentage crumb figures, analysed by Mr. Kerkham, showed no significant differences between no grazing, "light" grazing, and "heavy" grazing.

KAWANDA GRASS PLOTS.

These were sampled and examined for crumb structure. The plots after one year's cropping showed a marked drop in percentage crumb but it is not certain to what extent this may be due to a change of operators. The figures therefore will not be reported until the results of this year's sampling are available.

KACHWEKANO, KIGEZI DISTRICT.

A newly laid down grazing experiment was sampled and examined with the object of following changes due to treatments. Further samples will be taken at critical years for comparison and the results will then be reported.

BUKALASA, BLOCK E

Continuous cultivation for 19 years

Plot No.	% crumb		% crumb
1	22.5	1A rested one year under Kavirondo sorghum	21.6
2	20.5	2A rested one year under <i>Chloris gayana</i>	21.5
3	18.0	3A rested one year under <i>Setaria italica</i>	23.8
4	24.4	4A rested one year under natural regeneration	24.8

One year's rest does not appear to have made any recognisable improvement in structure.

Manures

Trials, principally of calcined Uganda Rock Phosphate, which had been begun in 1946 were continued. These were designed and analysed statistically by Mr. H. L. Manning before my arrival and are described by him in the report of the Botanical Section. So far the only responses of any magnitude have been obtained with nitrogenous fertilisers. Responses to the calcined phosphate have been small and of the same order as from the raw rock phosphate. During the current year (1948) trials on similar lines using Uganda Rock Phosphate in place of the calcined product are being conducted on maize and *eleusine* at the same centres.

Additional trials using superphosphate on *eleusine* and cotton in Serere and on sorghum in Kawanda are being conducted this year. In addition a comprehensive trial including lime, phosphate, potash and nitrogen is being conducted on maize at Buwunga in Masaka District.

COTTON SEED.

The position as regards the use (and misuse) of cotton seed has altered considerably during the war years. The bulk is now crushed in Uganda, the meal having a ready market as stock feed. Some uncrushed seed is made available by Government subsidy to *bona fide* African stock owners. It still remains to utilise the hulls which are removed by decortication before crushing. Much is used as fuel for the crushing machinery but a large part is burnt in dumps. A number of analyses of this material have been made and show it to be a potentially valuable manure. (Table 3)

TABLE 3
ANALYSIS OF COTTON SEED HULLS FROM DIFFERENT MILLS

	MOISTURE % COMPOSITION OF DRY MATTER				
	%	Nitrogen	Ash	K ₂ O	P ₂ O ₅
Kampala	11.9	1.05	3.25	1.16	0.36
Masaka	13.8	...	3.77	1.61	0.61
Kampala	13.2	2.06	3.42	1.74	0.98
Magodes (Budama) ...	13.0	0.86	3.24	1.65	1.07
Kampala	13.4	2.58	4.12	1.55	0.99
Pilitok	12.2	1.61	3.53	1.39	0.77
Kampala	13.4	1.54	3.67	1.45	0.53
Kampala	14.6	1.21	3.34	1.43	0.34
Kampala	13.3	1.53	3.29	1.43	0.42
Rappai	12.1	1.58	3.13	1.36	1.00

The variation in composition is due to admixture of kernel which varies with the efficiency of crushing. Objections to the use of hulls as manure are that they contain a proportion of viable seed and that they are bulky and wasteful of transport, objections which could be met by composting or pit rotting.

COMPOST

The composting scheme operated by the Kampala Municipality has now become firmly established. A small charge is now being made for the product. In the last three years tonnages issued to native farmers under the aegis of the Agricultural Department have been 1,925, 2,228, 2,136 in addition to quantities used by the Municipal authorities. The effect of the compost is most marked and in the opinion of the Agricultural Officer,

its use, together with the soil conservation methods which have been made a condition of its issue, has saved much worn out land near Kampala from complete destruction. A similar scheme has been started at Jinja and it is hoped that other townships will follow.

COFFEE HUSKS.

Much of the native-grown *robusta* is hulled after drying in the cherry. The hulls are at present a waste product but analysis shows them to be a potentially valuable manure. (Table 4). (They are also being fed experimentally to cattle at Kawanda).

Hulling factories within Kampala Township are obliged to remove the hulls two miles from the centre of the town. Under the guidance of the Department, the firms concerned dump the hulls at the roadside at selected points from where the cultivators carry it on to their land; over 1,500 tons have been thus utilised. It has proved a valuable manure and it is to be regretted that at factories outside the township, which are under no obligation to dispose of the hulls, vast stacks of hulls lie unused.

Feeding Stuffs.

At Kawanda where most of the coffee is pulped fresh the pulp has been fed to cattle with no ill effect. The pulp or hulls may prove a valuable addition to stock feed.

TABLE 4
COMPOSITION OF VARIOUS FEEDING STUFFS USED AT KAWANDA

	Mois- ture	COMPOSITION OF DRY MATTER					
		Ether Extract	Crude Fibre	Crude Protein	Ash	K ₂ O	P ₂ O ₅
Coffee Pulp ...	82.9	1.7	21.7	9.6	7.9	4.1	1.06
Coffee Hulls ...	13.1	1.7	30.0	12.5	6.2	3.0	0.36
<i>Pennisetum purpureum</i> (mature) ...	84.7	1.6	28.5	12.8	14.0	4.95	0.98
Sweet Potato <i>Ipomea</i> <i>bataas</i> (a) leaves	85.6	1.7	16.7	16.9	12.2	5.6	0.91
(b) roots ...	68.9	0.4	2.6	4.4	3.7	1.9	0.32
Cotton Seed ...	9.8	22.2	28.4	26.7	4.5	1.57	1.81

Cuttings from *P. purpureum* plots are being analysed monthly in conjunction with yield measurements and the results will be reported at a later date. It is interesting to note here that during April, that is on the onset of the rains, the plots were yielding at the rate of about 9 tons/acre/month. This figure taken together with the figure for crude protein, which is even higher in the monthly cut of grass, show what a large quantity of nitrogen must be consumed by the elephant grass. It is interesting to speculate on the fact that this consumption of nitrogen, which must occur through the agency of the soil, is accompanied by an increase in the organic matter and hence of the nitrogen of the soil. There is clearly room here for further enquiry.

MILKS.

In connection with feeding trials and the general breeding programme at Kawanda, monthly determinations of butter fat on all cows in milk were begun. Wide differences occur between the milk of different cows; a critical analysis of these differences will be made in a later report.

Nitrate Studies

In the report of this section for 1934 figures and graphs were given for nitrate determinations over a period of about two years. Attention was re-directed to these results by Mr. H. L. Manning, who was interested in this subject in connection with an argument which he has developed elsewhere regarding the planting date for cotton.

It was decided to re-open the investigation. A small plot (30 yards square) which had been under cotton the previous year was marked out. This plot was mulched in 5 yard strips with a 6" mulch of elephant grass, alternate strips being left bare of mulch; all plots being kept weeded. Composite samples have been taken weekly, since early November, at 0-6" and 6-12" from the clean-weeded and mulched plots. On these nitrate was determined by the distillation method (Soil and Plant Analysis (paper) p.206) and moistures were also determined.

It is intended to continue and to extend these observations for a year at least and therefore detailed results will not be given here. The results to date are so striking however that they merit a brief summary.

The 1934 figures which were from plots under coffee rose at times to the order of 10-13 mgms. NO_3 per hundred gms. dry soil. This figure in itself is sufficiently arresting as it implies .01 per cent. or more of NO_3 which in terms of a 6" acre (2,000,000 lbs.) means 200 lbs. per acre of nitrate nitrogen. The present series of results opened up with figures of the same order on both mulched and bare plots, which were maintained until the end of February over a period of four months in which rain was scanty and widely spaced.

During January it was decided to extend the observations to a strip of elephant grass elsewhere on the farm, which was scheduled for opening to cultivation this April. On this plot NO_3 nitrate has been found to be of the order of 1 to 2 mgms. per cent.

At the end of February, substantial rain fell and the NO_3 on the clean-weeded plot rose steeply to 26 mgms. per cent. At the same time it fell on the mulched plot to just over 2 mgms. per cent. On the elephant grass plot the nitrate remained steady at 1 to 2 mgms. per cent.

A dry spell followed when the bare plots fell back to 14 mgms. per cent. whilst the mulched rose to 6 mgms. per cent, the elephant grass plot remained steady at about 1 mgm. per cent.

At the beginning of April, after a completely dry interval of a fortnight followed by a few $\frac{1}{4}$ " to $\frac{1}{2}$ " showers, the bare plots rose to 38 mgms. NO_3 per cent (that is nearly 800 lbs. NO_3 per acre). The mulched plots fell slightly and the elephant grass plot remained steady.

It is too early to speculate on the reasons for these results; these may appear in the course of the work. The magnitude of the nitrate changes which presumably must involve the soil organic matter, have opened up a new and, it is hoped, a profitable field of enquiry which will be extended during the coming year.

Soils

Several hundred soil samples were examined during the course of the year. Many of these were in answer to enquiries regarding the suitability of land for tea growing. In Uganda it is now customary to advise that a pH not much in excess of 6 is permissible.

With the assistance of field officers, profile samples were obtained from most of the county agricultural centres and examination of these is in progress. The percentage of total exchangeable bases determined by the ammonium acetate method has been adopted as a routine determination.

An attempt was made during the year to bring together the available information on Uganda soils in the form of a descriptive schedule which is hoped with the critical comments of others may form the basis of a reliable descriptive account of Uganda soils.

SOIL CONSERVATION.

Kigezi was visited in August at the request of the Agricultural Officer, Mr. Purseglove, in order to judge the "finalists" in an inter-gombolola competition arranged by him. Considerable progress has been made in this district in protective work. Contour strips have been extensively planted of grass between cultivated strips and of trees on uncultivable hillsides so that it is no exaggeration to say that the whole appearance of the country has been altered in a most striking manner. The visible effect is more spectacular in the steep hills of Kigezi than in the flatter country of Teso where strip cropping is also now extensively practised. Many of the cattle tracks which scar the Kigezi hillsides have also been brought under control. Erosion is not a serious menace under Kigezi's conditions of soil and climate and the steps which are being taken should be an adequate safeguard.

Oil Seeds

COTTON SEED.

After an unusually wet harvest much cotton seed heated and spoilt in store. Oil mills claimed that this seed was reduced in oil content in proportion to the heating it had suffered. A test was carried out in a local oil mill. It was found that with a *worm expeller* badly heated seed clogged the screw and was uncrushable. Slightly heated seed yielded 6.1% of dark-coloured oil as against 8.6% of clear red oil for unheated seed. In the laboratory ether extraction gave oil contents of 21.1 per cent (badly heated) 21.5 per cent (slightly heated) and 20.5 per cent unheated, showing that the drop in yield at the mills is not due to a decrease in oil content.

Badly heated seed was fed to cattle at Kawanda without apparent ill-effect.

SOYA BEANS.

Varieties of Soya Beans grown for selection at Kawanda were examined for oil content with the following results (Table 5).

TABLE 5
OIL CONTENTS OF SOYA BEAN VARIETIES

Variety			Variety		
Moisture		Oil%dry wt.	Moisture		Oil%dry wt.
	%	%		%	%
R 184	12.6	23.5	35S 288	11.6	19.2
S 42	12.0	22.7	28S 5	10.9	18.5
H 49	11.6	22.1	29S 11	11.3	19.2
H 29	11.1	23.3	36S 58	12.2	21.6
H 7	11.5	23.7	34S 113	11.8	19.9
H 6	12.2	24.2	41S 77	11.5	18.6
H 18	11.9	21.6	"Toro"	11.6	20.4
34S 304	11.2	21.7	Macoupin	11.0	23.9
34S 395	11.5	22.1			

SHEA BUTTERNUT CAKE.

A sample submitted for analysis by a local firm contained 12.3% oil, 7.6% ash (0.99% K₂O, 0.14% P₂O₅) and 2.9% Nitrogen (all on dry basis).

SUNFLOWER.

Kawanda grown seed proved to contain 23.9% oil (dry basis).

Acknowledgments

I have to thank all field officers for their help during the year and in particular Mr. Hext who supplied some interesting notes on the soils of Busoga. I have worked throughout the year in the closest co-operation with Mr. H. L. Manning whose advice on statistical problems has been invaluable. Thanks are due also to Mr. Campbell, Chemist in charge of the Nicotine factory at Kabale, who has made such nicotine determinations as have been required.

G. AP. GRIFFITH,
Senior Chemist.

REPORT OF THE SENIOR BOTANIST

KAWANDA AREA

METEOROLOGICAL.

Rainfall during the first rainy season was adequate for all crops.

Sowing of food crops with the second rains were subjected to dry periods, the most serious of which occurred during the four months period November, 1947 to February, 1948. Cotton planted on the decline of the main rains yielded well; late planted cotton and all food crops sown with the poorly distributed second rains led to uniformly poor yields. The meteorological summary in Table 1 includes Average Temperature (Mean

of Maximum and Minimum) and Mean Daily Hours of Sunshine. It should be noted that these sunshine data were obtained from a Jordan Recorder. At Kawanda where a Campbell-Stokes Recorder is now also available, it has been observed that there is a discrepancy between the two instruments. For low reading (2 hours per day or less) the Jordan instrument differs by as much as two hours per day; for the highest readings the differences are negligible.

TABLE I
SUMMARY OF METEOROLOGICAL DATA FOR KAWANDA

Month	1947 Rainfall	Rainfall Days	10 years Average Rainfall	9 years Mean Aver. Temperature	4 years Mean Daily Sunshine
January ...	4.40	15	1.86	71.9°F	5.67
February ...	1.96	10	2.51	72.3°F	5.85
March ...	3.57	14	4.17	72.1°F	6.00
April ...	6.69	19	6.09	71.6°F	5.05
May ...	4.77	22	5.76	70.5°F	4.96
June ...	3.53	8	2.39	69.4°F	4.92
July ...	2.19	12	2.12	68.6°F	3.31
August ...	2.44	8	3.49	69.2°F	3.70
September ...	5.94	13	3.82	70.2°F	4.60
October ...	2.65	9	3.74	71.8°F	4.89
November ...	1.39	9	4.51	71.4°F	5.05
December ...	1.88	10	2.82	71.0°F	6.18
TOTALS ...	41.31	149	43.28		
MEANS ...				70.8°F.	5.02*

* Mean daily hours of sunshine from a Jordan Recorder.

Rainfall during January, 1948 (not included in the Table) was only 1.29", which fell during 8 days.

Part I Cotton

GENETICS AND BREEDING.

BP 52 Breeding Work.—The most important phase of this work was that concerned with the purification of the BP 52 stocks. The preliminary stages have been outlined in a previous report. During the season progeny rows of bulked selfed single plants were grown. The rows were made up of 16 of the 150 originally selected; bulked selfed seed of 5 original lines; and 2 commercial re-selections.

About the time of flowering, plants with completely undesirable plant habits were eliminated. Number of days to first flower, with the node number, was recorded for each of remaining plants. Unselfed seed cotton was reaped by rows to provide estimates of boll number and size. Selfed seed cotton from each of the plants was analysed separately for the characters mean maximum lint length (Bailey Protractor on three per plant), lint per seed and seed weight.

Variation between plants and between lines was higher than would be expected with closely related pure lines—(for mean lint length C.V. 7.2%; lint per seed C.V. 14.0%). Since these data did not fit an expected normal distribution—there was less than one chance in a thousand that the deviations were chance variation—it may be inferred that these BP 52 lines

require further sorting; it is probable also that selection advances would still be obtained from plant to row selection.

Uniformity of staple length is considered to be one of the more important aims. High lint per seed also is considered to be desirable. A model bulk was made at the end of the season using as criteria for rejection the ranges—one standard deviation for each of the characters lint length and lint per seed. The considerable reduction in the number of plants which fulfilled these conditions left 235 with lint length range 28.7 to 32.3 mms; the lint per seed range was 41.0 to 53.0 dgms. Additional selections included 8 single plants which satisfied the conditions of high lint per seed and high lint length. Variable bulks were made from seed of selfed plants for each of the 23 lines.

BP 52 Multiplication.—The results from the Special Survey conducted during 1946-47, indicated that several areas in the seed replacement scheme urgently required new seed. For the coming season the entire Masaka area is to be replaced with BP 52 seed from the Bale segregated area. This in turn will receive seed from Kawanda Seed Farm, which receives its seed from the 20 acre increase area on the Research Station. The seed grown on the latter area during the past season is B/C 66 which is a 3rd back-cross to BP 52 of the B 181 × BP 52 hybrid. It is heterozygous for Blackarm resistance and spinning tests, both large scale and small scale, have shown it to compare favourably with BP 52.

One of the weaknesses of the seed replacement scheme is that the seed supply from the Seed Farm stage to the Bale area is too small to supply the latter. It is shown below that the expected yields from the Research Station are adequate to supply seed for a larger area than the Seed Farm. Were it possible to increase this latter area the rate and quantity of seed supplied would be greatly increased.

The yields per acre of the Kawanda Research Farm are of some interest providing some information on optimum time of planting and also the basic nucleus of seed for the replacement scheme. Yields of clean seed cotton per acre are given for the 7 seasons 1941-42 to 1947-48 in Table 2.

TABLE 2

SUMMARISED YIELDS PER ACRE OF CLEAN SEED COTTON FROM THE 20-ACRE INCREASE AT KAWANDA FOR THE PAST SIX SEASONS. ACREAGES GIVEN IN PARENTHESES

Season	MONTH OF PLANTING					MEANS
	April	May	June	July	August	
1941-42 ...	...	721 (18.0)	770 (1.9)	...	...	726
1942-43 ...	...	968 (6.2)	950 (12.0)	724 (2.0)	...	933
1943-44 ...	...	543 (6.1)	521 (10.9)	371 (3.9)	...	499
1944-45 ...	177 (3.2)	281 (10.7)	798 (5.1)	538 (4.1)	...	426
1945-46 ...	...	...	959 (6.5)	893 (10.7)	712 (3.3)	885
1946-47 ...	...	456 (5.6)	517 (4.4)	491 (7.5)	494 (5.0)	488
1947-48 ...	...	732 (5.2)	675 (0.4)	570 (16.1)	327 (1.9)	588
Means ...	177	611	762	621	533	640
% Stained ...	36.1	11.1	4.9	9.2	10.4	

Average Yield/Acre Clean Seed Cotton=640 lb.

Average Yield/Acre Total Seed Cotton=712 lb.

It is well known that food crops are grown during the first rains. Planting of cotton must therefore take place either during the harvesting period, or later. Reference to Table 1 shows that for the Kawanda area there is a well-marked difference between the two rainy seasons. Planting of cotton could be carried out either during the decline of the main rains—late May or early June—or await the onset of the second rains towards the end of July or early August. The yields per acre derived from relatively large areas over the seven seasons, show that the highest total yields have been derived from sowings in May. At the same time it will be observed that the percentage of stained cotton from such sowings is relatively high. This is probably due to high rainfall at maturity, particularly for the earliest sowings, and to some extent the high level of Blackarm, stainer and bollworm attack. The June sowings, which lead to the highest average yield of clean seed cotton, tend to have less severe *Lygus* attack. Late sowings, particularly those in August and September, often suffer from inadequate rainfall during the later stages of growth and, with the protracted growing season expected under these climatic conditions (see Table 1), tend to ripen during the onset of the main rains of the following season. There can be little doubt then that for the Kawanda area the sowings during the latter part of May or early June lead to the highest yields.

From the early June sowings it is apparent that seed cotton yields (First Grade) from the 20 acres would be expected to provide a minimum seed supply of about 10,000 pounds. Were more land available for the next stage this would be sufficient for about 500 acres.

Blackarm Resistance.—The importance of resistance to *Bacterium malvacearum* has been stressed in previous reports. Transference work involving the B2 gene was continued during the past season. There are now available for sorting, under more suitable climatic conditions than Kawanda, 4th, 5th, 6th, 7th, and 8th back-crosses on to BP 52 of the original B 181 × BP 52 hybrid.

Seed Type.—Further back-crosses were made on to BP 52 of the naked and tufted types.

Hairiness.—The project to combine the long plant hairs of MU8A with the dense hairs of *Gossypium tomentosum* was carried a stage further. Some promising material will be planted out for later single plant selection during the coming season.

Verticillium Wilt.—External symptoms of this wilt were observed during the season. As before, the resistance of B 181 was highest. BP 52 also showed considerable resistance. The BP 50 strains and many of the hybrids from Barberton were highly susceptible. The inoculation technique previously used for this important work is suspect, and further investigational work has been suspended until a more reliable method becomes available.

Other Breeding Work.—Variable bulks were maintained of the more important varieties grown in the Protectorate. In addition small areas were grown of lines of B 181, etc.

AGRONOMY.

Fertiliser Trials.—Evidence of a variety × fertility interaction was adduced in the previous report. During the past season a fertilizer trial

was conducted to investigate further this important indication. The trial, a $3 \times 3 \times 3$ design with the three factor interactions completely confounded; had three varieties of BP 52 — a BP 52 bulk, BAR 12/3 a 5th back-cross to BP 52 from Sudan, and B/C 66 a 3rd back-cross to BP 52. The last two strains were resistant to Blackarm. Other treatments were three levels of nitrogen as sulphate of ammonia (0, 1 and 2 cwt./acre) and three levels of rock phosphate (0, $2\frac{1}{2}$ and 5 cwt./acre). The rock phosphate was applied in holes close to but not in direct contact with the seed at planting towards the end of May. Nitrogen was drilled in about four weeks after planting. Since the land was in the fourth year of cultivation after a grass ley, and was sloping, it was considered desirable to plant the cotton on ridges mainly as an anti-erosion measure.

Plant emergence counts at 14 days indicated that rock phosphate had stimulated germination. This early stimulus was reflected in plant height at 98 days. The response for one strain—BP 52 bulk—was of the order of 15 per cent; the response to nitrogen of the same strain was only 6 per cent. Responses of the other strains were negligible. Counts of early shedding (buds and bolls) showed that there were significant increases for all strains due to nitrogen. The statistical significance of the $V \times P$ interaction was due almost entirely to greater shedding in the BP 52 bulk with added phosphate. Yield levels were high for all varieties though differences could be demonstrated. Total seed cotton per acre was 1,342 lbs. for BP 52 bulk, 1,256 lbs. for BAR 12/3 and 1,213 lbs. for B/C 66. Again the statistical significance of the $V \times N$ interaction was due almost entirely to the greater response to nitrogen of BP 52 bulk. It is apparent that this strain responds more favourably to higher fertility conditions than does B/C 66. It is possible that B/C 66 with slightly higher boll weight, will prove more suitable under low fertility conditions than BP 52 bulk. It is interesting to note that this area in the fourth year of cultivation gave the highest yields of seed cotton at Kawanda during the past season. Yields during the previous three seasons when cotton was planted on the flat, were 591, 803 and 622 lbs. per acre. The average yield from the 0.9 acres of the experimental area was 1,270 lbs. per acre. It is possible that ridge cultivation in such a year contributed to the high yield level.

Yields for the main effects are given in lb. per acre in Table 3.

TABLE 3
Yields of Seed Cotton per Acre

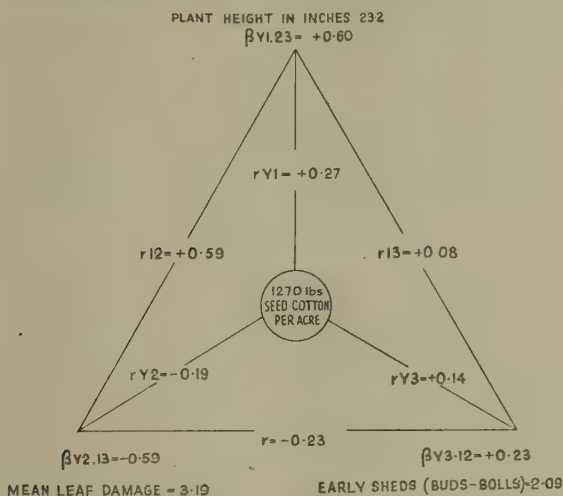
<i>Varieties</i>	<i>Nitrogen</i>	<i>Rock Phosphate</i>
(BP 52 bulk) ...	1,342 (0N) ...	1,253 (0P) ...
(BAR 12/3) ...	1,256 (1N) ...	1,285 (1P) ...
(B/C 66) ...	1,213 (2N) ...	1,272 (2P) ...
General mean 1,270 lbs. per acre		

An attempt was made to relate *Lygus* leaf damage counts to final yield of this experiment. A multiple regression analysis was carried out on data for plant height, leaf damage counts and estimates of early shedding at 98 days, in relation to final yield. The estimates were based on means of 20 plants from each of 108 plots. *Lygus* damage counts estimates by the Entomological Section, are on the arbitrary scale 0-10. Early shedding includes

buds and early bolls, and was estimated by an arbitrary classification of scars up to and including the most recent flower. The leaf damage and shedding counts were transformed according to the identity $X-0.5$. The data are shown graphically in Diagram 1.

DIAGRAM 1

The multiple regression of yield on plant height, capsid leaf damage and early shedding. Data taken at 98 days from a 3^3 fertiliser trial with 3 varieties of BP 52; 3 levels of Nitrogen; and 3 levels of rock phosphate. Planted 28th May on 4th year land.



Two important inferences may be drawn from these data. Firstly the relationship between *Lygus* incidence, as measured by leaf damage counts, and plant height, is confirmed. Plant height at 98 days may be taken as an index of vegetative vigour since the relationship between height and shedding was not close. It would appear then that height preceded the *Lygus* attack in this experiment. The second important inference is that leaf damage counts are in fact related to crop losses. The standard partial regression co-efficients, i.e. the estimated independent effects due to the various characters—show that vigorous plants generally yield well ($B Y1.23 = 0.60$); at the same time these plants appear to be more attractive to *Lygus* ($B Y2.13 = -0.59$); the relationship between early shedding and yield, though relatively small, was statistically significant, and confirms experience elsewhere. It should be noted that the level of *Lygus* attack was not high (General mean 3.19 per plant) and that yield levels (General mean 1,270 lb.) were much above the average.

An additional fertilizer trial, also a 3^3 design, but with a split-plot arrangement, was also conducted during the season. The three treatments were: Time of preparation of land newly opened from elephant grass (*Pennisetum purpureum*), Spacing ($3' \times 1'$; $3' \times 2'$; $3' \times 3'$) and added Sulphate of Ammonia (0.1 and 2 cwt. per acre). One of the main objects of this experiment was to determine the optimum time of final preparation of the land after a February ploughing of the elephant grass residue. The 15-week period from ploughing to planting was therefore arranged into three groups: 6 weeks after ploughing with the final preparation 9 weeks before planting; 9 weeks and 6 weeks; 12 weeks and 3 weeks. Elephant grass is of course

a gross feeder and under these conditions the plant residue after a 4-year ley is quite considerable. Where cotton is planted too soon after opening a temporary nitrogen deficiency might therefore be expected.

Germination and early growth were satisfactory. Yield differences due to spacing and added nitrogen were statistically significant. Although differences due to time of preparation were not statistically significant, the two later dates led to higher yields. Since there were no significant interactions the main effects may be taken as real and are given in Table 4 in pounds of seed cotton per acre.

TABLE 4

Time of Preparation	Spacing	Nitrogen
6 weeks to 9 weeks 797	(3'×1') 870	(ON) 789
9 weeks to 6 weeks 836	(3'×2') 817	(1N) 829
12 weeks to 3 weeks 821	(3'×3') 768	(2N) 836

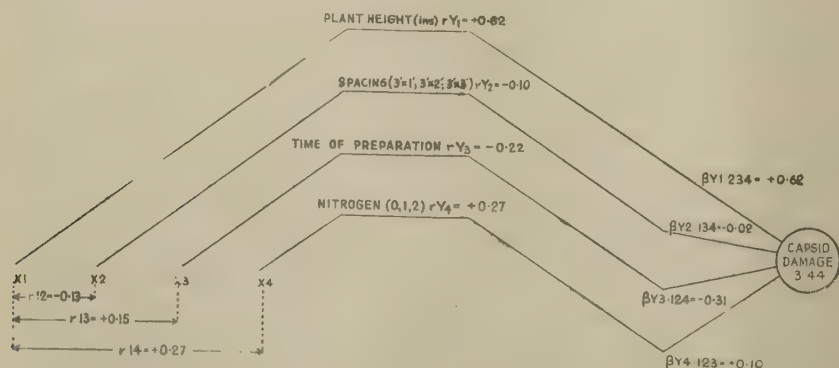
General mean 818 lb. per acre.

The increase in yield with closer spacing is practically linear and confirms previous work. It is interesting to note also that there is a small yield response to added nitrogen on land newly opened from elephant grass. For time of preparation the results are conclusive though there is some evidence that the period between ploughing and final preparation should be more than three weeks. This important cultural operation must therefore be the subject of further investigation.

Pursuing the important relationship between *Lygus* and yield, an additional attempt was made to clarify possible confusion of apparent effects. A multiple regression analysis, similar to that used for the other fertilizer trial, was calculated with data on plant height, spacing, time of preparation and added nitrogen. The important difference was that field observations were made at 84 days. Since the mean number of days to first flower was found to be 96.8 for late May or early June sown cotton, it may be assumed that early shedding would not be great. The mean node number at which these plants flowered was 7.1. The multiple regression data are shown graphically in Diagram 2.

DIAGRAM 2

The multiple regression of capsid leaf damage on plant height at 84 days, spacing (3'×1'; 3'×2'; 3'×3'), time of preparation and added inorganic nitrogen. Experiment on newly opened land. Planted 21st May.



Arbitrary values were assigned to spacing and nitrogen in ascending order. For time of preparation the earliest was 9 weeks before planting decreasing to 3 weeks, so that the arbitrary scale was in descending order.

It will be observed from Diagram 2 that a close relationship exists between plant height and *Lygus* leaf damage. The effect of nitrogen would appear to be due to its effect on plant height. Since no extensive shedding would be expected to take place at 84 days, plant height may be regarded as an index of vegetative vigour, and bud shedding would not have contributed to this height. It must be concluded from these experiments that vegetative vigour is attractive to the *Lygus* in the first instance. Confirmatory evidence is provided by the effect due to spacing; that is, the closest spacing tends to have taller plants. The estimate of the independent effect due to spacing is given by the standard partial regression $B_{Y2 \cdot 134}$ which is only -0.02. The unexpectedly high standard partial regression for time of preparation may be due partly to height, which was greatest for the earliest preparation.

In conclusion it may be re-affirmed that there is now some evidence that at least a part of the relationship observed between *Lygus* attack and plant height of mature plants may be due to early attraction of vigorous plants. A later effect resulting from bud and boll shedding may also contribute to the main stem elongation so characteristic of *Lygus* attack as measured by leaf damage counts of 4.0 or more. It is of interest to note also that the existing method of estimating leaf damage has in fact some relationship to final yield.

Sowing Date Trials. Kawanda.—Considerable attention has been devoted to the important question of optimum time of planting. A comprehensive trial was conducted at Kawanda during the previous season. For this area it was inferred that earlier planting, with an optimum towards the end of May or early June, led to the highest yields. In addition, there was some evidence that the growing season was protracted under climatic conditions experienced in the Kawanda area.

During the season a trial was conducted during the normally less overcast period February to June. The design, a simple randomised complete block arrangement, and 9 sowing dates at intervals of 14 days from February 19th to June 11th. Unusual rainfall conditions prevailed during January and February (see Table 1), and both daily hours of sunshine and average temperatures were below the means. The sowings during March and April, flowered appreciably earlier when it was warmer, than the later sowings. Those from the beginning of May were typical of results obtained in other seasons. *Lygus* leaf damage counts were recorded and in addition plant height and potential fruiting points. Since the incidence of boll worm was high (notably *Argyroplote* sp., *Earias* sp., and *Platyedra* sp. in order of quantity), no attempt was made to estimate yield. Data from this trial are presented in Table 5.

TABLE 5

	OBSERVATION				
	Days to 1st flower	Height in Cms. at 162 days	<i>Lygus</i> damage per plant	Fruiting points	Shedding %
19th February ...	93.0	101.2	2.85	78.3	84
5th March ...	82.0	103.7	2.05	83.0	83
19th March ...	83.3	89.2	2.55	49.3	79
2nd April ...	83.0	85.9	3.30	36.9	83
16th April ...	90.7	90.0	3.45	37.7	89
30th April ...	89.8	97.2	3.20	48.3	85
14th May ...	97.8	92.0	1.80	37.2	79
28th May ...	98.9	88.0	2.30	40.5	79
11th June ...	100.6	85.5	2.15	38.9	72

There is now additional evidence that the length of the growing season for cotton, in this area, is extended during the periods of overcast days. Very early sowings of cotton flower during the relatively warm month of May. There is of course no intention to plant cotton on a commercial scale during this period, and the experiment was conducted with the main object of estimating the likely reduction of the cropping period. For flowering the greatest reduction was only two weeks. The reduction of the length of season is not sufficient to avoid the onset of the second rains which would occur during the harvest of such early planted cotton. The further information obtained from this trial is that concerning possible *Lygus* damage over a range of planting dates from February to June.

A sowing date trial, of the design given in detail in the last report, was conducted at Kabula in the south-west of Buganda. Unlike the remainder of Buganda the main rains occur during the second half of the year. There were 10 planting dates at intervals of 14 days from September 13th, 1946, to January 17th, 1947, and at each locality a two-thirds overlap in time. The altitude of the experimental area was just over 4,000'. The growing period from planting to harvest was, for the later treatments, about nine months. Yields per acre of total seed cotton for the various dates are given in Table 6.

TABLE 6

13th September ...	... 1,821	22nd November ...	... 705
27th September ...	... 1,316	6th December ...	... 568
11th October ...	... 1,247	20th December ...	... 542
25th October ...	... 1,058	3rd January ...	... 550
8th November ...	... 714	17th January ...	... 490

It is apparent that sowings after the end of October lead to markedly reduced yields. That high yields can be obtained with sowings on the decline of the main rains during October is however demonstrated. One of the striking features of the experiment was the development of the individual plants. Unlike those usually observed in Buganda, plants from the sowings in September and October were of a pyramidal shape with well-developed sympodia. Insect pests and plant diseases were at a low level throughout the ten months period of the trial.

Part 2—Food Crops

GROUNDNUTS.

Two factorial fertilizer trials were conducted; one at Kawanda and one at Serere. The varieties chosen were B 229, which has a large number of small nuts, and B 227 which has rather fewer but larger nuts. These varieties are amongst the highest consistent yielders over a number of years.

Treatments were 3 levels of sulphate of ammonia (0, 1 and 2 cwts. per acre) and for Kawanda 0, 1, 2 cwts. per acre of calcined phosphate; for Serere, rock phosphate was used instead of calcined with the same application of nitrogen. All fertilizers were applied in rows about 2" from the plants at flowering (about one month after planting).

At Kawanda there was a highly significant difference between varieties—the B 239 outyielding B 227; the single level of calcined phosphate gave a yield increase of 16 per cent., though the double dressing was depressing.

At Serere the single level of nitrogen gave a yield increase of 16 per cent. and the double dressing was depressing. The differences between varieties and those due to rock phosphate were no greater than could have occurred by chance.

It may be inferred that whereas a small yield increase was obtained from calcined phosphate in the one case and sulphate of ammonia for the other, the depressing effects due to the heavier applications suggest that these fertilizers could not be recommended for general use.

SWEET POTATOES.

Previous experiments in this area have indicated that yields are usually at an optimum for cropping periods of the order of 200 days. During the season an experiment was conducted with all combinations of 4 varieties $\times$ 3 planting dates $\times$ 3 lifting dates.

The varieties were two standards of high cropping capacity—Namujuna and Kalebe—and two others said to have a high carotene content—Kayulu and Mameita. No information was available for the cropping period or yield levels for the last two varieties.

Highest yields were obtained from the combination of the earliest planting date and the latest lifting date—mid-March to mid-October—thus confirming the trial of the previous season. The percentage of rotten potatoes was only 1.8 for the longest cropping period.

Differences between varieties were large, the yields in tons per acre were 6.36 for Kalebe, 5.76 for Namujuna, 4.47 for Kayulu (a yellow potato) and 3.54 for Mameita, which probably has as high a carotene content as Kayulu. There was a significant interaction between variety and planting date. This was due almost entirely to Mameita whose yield level—unlike the other varieties—was highest for the mid-May planting.

Details of the analysis of variance for the split plot design are given in Appendix 1.

A large number of introduced varieties, which will be tested against the standards, have been maintained during the year.

ENGLISH POTATOES.

Sprouted potatoes were grown in shallow trenches by the method described in the last report. Yields of the standard varieties were below

average. Again the Toro Blue outyielded all others giving 3.35 tons per acre. Nanyuki and Rhode Star yielded respectively 2.15 and 1.44 tons per acre.

Multiplication of small stocks of Kerr's Pink, King Edward, Salaman Clarke II and some hybrids from Kenya, was continued. Sufficiently large stocks of some of these will be available in the coming season for large-scale variety testing.

A large collection of South American potatoes obtained through the courtesy of the Imperial Bureau of Plant Breeding and Genetics at Cambridge were planted out in small observation plots. Of the original number of single tubers (100) about 35 appear to show some promise. It is of course too early to report on their cropping capacity which will be investigated as soon as sufficient promising bulked material becomes available.

Owing to the failure of the second rains there was no late crop of potatoes.

MAIZE.

Maize investigations were conducted firstly with fertilizers and secondly with multiplication of breeding stocks.

The aim of the fertilizer trials was to determine the possible response to calcined rock phosphate and sulphate of ammonia. Trials were laid down at 4 centres in Buganda. Treatments were 0, 1, 2 cwt. acre of sulphate of ammonia and 0, 1, 2 cwt./acre of calcined phosphate all applied in drills 2" from the plants about 4 weeks after planting. There were two replications of the 9 treatments combinations at each locality. At three of these centres Bukalasa, Kakumiro and Ngogwe the land had been under grass for some years; for the first two elephant grass and the last "Tete". At Kawanda the land was in the second year of cultivation.

Differences due to inorganic nitrogen were large. The response was practically linear, indicating, for the serial analysis, that additional increases could be expected from larger applications of sulphate of ammonia. Yield responses to calcined rock phosphate were negligible. The small depressing effect was not statistically significant. Differences due to localities were not unexpected, since some had been newly opened after 8 years under elephant grass. However, since there was no significant locality $\times$ nitrogen interaction, it may be inferred that responses to this fertilizer would be of the same relative magnitude, whether on newly opened land or that in the second year of cultivation.

The serial analysis of variance of these data is given in Appendix 2.

Additional breeding work was conducted on some promising Kenya strains, both white and yellow. The highest yielding types were K₄, K₅, K₆, K₁₃ and K₁₅.

SOYA BEANS.

Variety testing has been the most important phase of soya bean improvement for the last three seasons. Pursuing this line, a cubic lattice with 27 varieties was laid out during the first rains. Germination was poor—mainly due to inadequately dried seed from the previous year—and no analysis of the yield data was practical. The varieties were bulked for

multiplication, and with a further ten were planted during the second rains. It will be observed from Table 1 that these rains were inadequate and, though an adequate amount of seed was obtained, yield levels were low. It is proposed to repeat the test during the coming season using better seed obtained with the drying floors, which have recently been constructed.

During the season an experiment was designed to investigate allegations made by certain growers regarding the supposed harmful effect on later crops of soya beans grown for seed.

Three crops, maize, soya beans and local beans were grown in three replications during the first rains. Although differences between replications were large they were no greater than could easily have occurred by chance. Yields per acre are given in Table 6.

TABLE 6

<i>Soya beans</i>	<i>Local beans</i>	<i>Maize</i>
520	803	2,195
520	1,040	1,882
900	1,064	2,931

During the inadequate second rains the nine permutations for each of these crops following itself and the others, gave the following yields also in lb. per acre.

TABLE 7
CROPS BELOW FOLLOWED

		<i>Soya beans</i>	<i>Local beans</i>	<i>Maize</i>
		<i>lbs.</i>	<i>lbs.</i>	<i>lbs.</i>
These crops preceded	{ Soya beans ...	342	506	863
	{ Local beans ...	350	365	773
	{ Maize ...	327	543	737

Since the fertility trend, as indicated by yield levels with the first rains, was so heterogeneous, it was not possible to evaluate the regression of second yields on first yields of the same plots. It was hoped that, with such a technique, reduction of much of the environmental variation would facilitate the interpretation of these data. However, it is evident, even with unadjusted data, that there can be no marked depressing effect of soya beans on yield of crops which follow; that is, yield levels of each of the three crops were higher in two and only slightly lower in one instance (soya beans). These results, though referring to the crop grown for seed, are in general agreement with results obtained by other workers (*J. Amer. Soc. Agron.*).

ELEUSINE.

The most important areas for finger millet (*Eleusine coracana*) are the Eastern and Northern Provinces. No selection work has been conducted in Buganda, other than maintenance of the more important types. Yields in Buganda were, however, at a relatively high level, being for Engenyi 2,908, Buganda mixture 2,731, Ekwakoit 2,281, and the Eastern Province mixture 1,692, all in lbs. per acre of unthreshed heads.

Fertilizer trials with finger millet were conducted at a large number of centres in the Eastern Province. There were two main groups; the first included centres at Kibale, Budala, Kisoko and Vukula east of the Nile

and south of Lake Kioga; the second with centres at Katakwi, Kuju, Kumi and Bukedea representing north-east Teso and the Lake Kioga littoral. Two additional centres were at Kaberamaido and Serere.

Three levels each of sulphate of ammonia (0, 1, 2 cwt./acre) and calcined phosphate (0, 1, 2 cwt./acre) were applied broadcast about four weeks after planting with two replications at each site.

The serial analyses of variance indicated that there were large and highly significant yield increases for all groups with sulphate of ammonia. For the first group, increases due to 1 cwt./acre was 29 per cent., and for the double dressing 40 per cent. Yield increases for the second group were of similar magnitude being 23 and 43 per cent. Responses to calcined phosphate were negligible. In neither group was the locality $\times$ treatment interaction statistically significant.

It was inferred from these data that nitrogen, as sulphate of ammonia provided the greatest single stimulus to yield and confirmed the inferences from trials conducted in the previous year; namely, that the independent effect of 2 cwt./acre of sulphate of ammonia led to yield increases of the order of 40 per cent; also that there was no nitrogen $\times$ phosphate interaction.

Analyses of variance for these trials are given as Appendices 3 and 4.

SORGHUM.

No breeding work has been attempted during the year. A comprehensive fertilizer trial was, however, carried out during the second rains at the Kawanda Station. The two local phosphate sources, rock and calcined phosphate each at three levels (1, 2, 3 cwt./acre), with and without nitrogen, phosphates applied in drills or broadcast, early and late were compared in a comprehensive lattice square which had no dummy treatments. The failure of the second rains resulted in generally low yield levels (780 lb. p.a. of unthreshed grain). Differences between treatments were small—the average effect of calcined phosphate being 105 per cent and rock 101. There were small differences in favour of early over late and, unexpectedly, broadcast over drilled. However, since these differences were not statistically significant, these inferences should be taken with reserve.

CASSAVA.

Attention has been drawn to the serious limitations imposed by incidence of the mosaic virus on cassava, particularly in the Northern and Eastern Provinces. Mention has been made of the introduction of resistant varieties. Test plots throughout the Protectorate have now been grown for some years. There has, in consequence, been a reduction of the number of suitable varieties both in point of edibility and those showing effective resistance.

A comprehensive trial was laid out in March with 5 resistant varieties and 12 established standards, and to be lifted at intervals of three months from the sixth to the twenty-fourth month.

At the time of writing two reapings have been completed and although a full statistical analysis is not practical, one of the resistant varieties, No. 36, has yielded, at six months, at the rate of 7·8 tons per acre. Full details will be available in due course.

Adjacent to this experiment unreplicated plots have been laid down. These will provide some information on the storing capabilities of these varieties from 12 to 48 months, with lifting dates in intervals of 6 months.

BANANAS.

An 8×8 Latin square containing 8 varieties of the cooking banana (Nkago) was begun two seasons ago. Owing to shortage of planting material and the large plot sizes (40 holes each) it has only been completed during this season. A preliminary comparison of elephant grass mulch and cattle manure each on half of the plots in one direction was made during the year. Yield data are not yet available.

MISCELLANEOUS.

Peas, Beans, Groundnut varieties and Yams were maintained during the year.

H. L. G. MANNING,
for Senior Botanist.

Appendix 1.

SWEET POTATO VARIETY×PLANTING DATE×LIFTING DATE TRIAL, 1947

<i>Varieties</i>	<i>Planting Dates</i>	<i>Lifting Dates</i>
Namujuna ...	... mid-March	... mid-August
Kalebe ...	... mid-April	... mid-September
Kayulu ...	... mid-May...	... mid-October
Mameita		

Ridges 3' apart. Planted 2' within rows. Plot size 1/110 acre:
3 Replications.

ANALYSIS OF VARIANCE

Due to	d. f.	S.S.	M.S.	f.	p.
Replications ...	2	64,840·0	32,420·0	5·44	0·05*
Planting Dates—					
Mid-March <i>vs.</i> Remainder ...	1	79,964·5	79,964·5	13·41	0·05*
Mid-April <i>vs.</i> mid-May ...	1	1,058·0	1,058·0	...	N.S.
Error (a) ...	4	23,847·9	5,962·0	...	...
Lifting dates ...	2	86,758·9	43,379·5	9·36	0·01**
Planting Dates × Lifting Dates ...	4	40,537·0	10,134·3	2·19	N.S.
Error (b) ...	12	55,615·5	4,634·6	...	...
Varieties ...	3	54,017·9	18,005·0	5·09	0·05*
Planting Dates × Varieties ...	6	56,098·0	9,349·7	2·65	0·05*
Lifting Dates × Varieties ...	6	18,140·1	3,023·4	...	...
Planting Dates × Lifting Dates × Varieties ...	12	39,589·7	3,299·1	...	...
Error (c) ...	54	190,877·9	3,534·8	...	...
TOTAL ...	107	711,345·4			

FERTILIZER TRIALS WITH MAIZE IN BUGANDA

DESIGN 3×3 Centres *Kawanda, Bukalasa, Kakumiro, Ngogwe.*Plot size $1/58$ acre: Spacing $3' \times 2'$. 2 Replications at each locality.
(Planted early March, Reaped September)

ANALYSIS OF VARIANCE

Due to	d.f.	S.S.	M.S.	f.	p.
Localities ...	3	3,064.5	1,021.5	6.48	0.01
Blocks in Reps. ...	4	2,730.5	682.6	4.33	0.01
Nitrogen—Linear ...	1	2,146.7	2,146.7	13.62	0.001
Quadratic ...	1	70.8	70.8	...	...
Phosphate—Linear ...	1	63.0			N.S.
Quadratic ...	1	62.7			
Interactions—					
Nitrogen $\times$ Phosphate ...	4	183.4			N.S.
Locality $\times$ Nitrogen ...	6				
Locality $\times$ Phosphate ...	6	1,413.4	58.9		
Locality $\times$ N $\times$ P ...	12				
Error ...	32	5,044.0	157.6		
TOTAL ...	71	14,779.0			

Mean yields for localities (maize on the cob lb./acre).—

Ngogwe 3,222, Kawanda 3,603, Kakumiro 3,684, Bukalasa 4,276.

Appendix 3.

ELEUSINE TRIALS IN THE EASTERN PROVINCE, 1947

Centres *Kibale, Budaka, Kisoko, Vukula*: Design 3×3 .Plot size $1/45$ acre; 2 Replications at each locality

Due to	d.f.	S.S.	M.S.	f.	p.
Localities ...	3	16,684.4	5,561.5	32.27	Very small
Blocks in Reps. ...	4	3,305.4			
Nitrogen—Linear ...	1	4,981.4	4,981.4	28.90	Very small
Quadratic ...	1	323.1			
Phosphate ...	2	803.2	401.6	2.33	Not significant.
Interactions—					
Nitrogen $\times$ Phosphate ...	4	164.5			
Localities $\times$ Treatments ...	24	8,128.0	338.7	1.96	Not significant.
Error ...	32	5,514.1	172.3		
TOTAL ...	71	39,904.1			

Mean yields for localities (unthreshed heads lb./acre).—

Vukula 2,022, Kibale 2,349, Budaka 3,088 Kisoko 3,793.

ELEUSINE TRIALS IN THE EASTERN PROVINCE, 1947

Centres: *Katakwi, Kuju, Kumi, Bukedea*. Design: 3×3 .Plot size $1/45$ acre. 2 Replications at each locality.

ANALYSIS OF VARIANCE

Due to	d.f.	S.S.	M.S.	f.	p.
Localities	3	10,186.4	3,395.5	44.45	Very small.
Blocks in Reps. ...	4	541.7	135.4		
Nitrogen—Linear ...	1	3,513.5	3,513.5	46.00	Very small
Quadratic ...	1	5.7			
Phosphate	2	78.0			
Interactions—					
Nitrogen $\times$ Phosphate ...	4	175.2			
Localities $\times$ Treatments ...	24	534.8			
Error	32	2,444.2	76.4		
TOTAL	71	17,479.5			

Mean yields for localities (unthreshed heads lb./acre):—

Katakwi 1,447, Bukedea 1,960, Kuju 2,652, Kumi 2,656.

REPORT OF THE ENTOMOLOGIST, KAWANDA

This report covers a period of eighteen months. Work has been concentrated on general pest surveys and estimates of damage, rather than on research into special problems.

Sampling

2. A system of routine examination of coffee samples has been started, in order to assess the losses from different causes in different areas and their variations from time to time.

Antestia

3. *Antestia* has spread round the lower slopes of Ruwenzori. It has been very serious locally in Western Uganda, but in many parts owners of small plots have had useful returns in spite of the bug, which is often used by unwilling growers as an excuse for neglecting coffee. In the east *Antestia* has not been really serious, though it continues to cause appreciable loss of crop.

4. The Stylopid parasite, *Corioxenos antestias* Blair, was introduced to two localities in Toro and Bugishu respectively a few years ago and still flourishes there. It appears to be easy to establish, but it spreads excessively slowly. In the Bugishu centre, at least, it does not seem to have reduced the *Antestia* very much, in spite of parasitising 22% of the adult bugs.

5. There is evidence that *Antestia* travels very little. If confirmed, this will remove one difficulty in chemical control in small native plots, where it has been feared that an energetic man may suffer from bugs left unmolested in his lazier neighbours' plots.

6. Trials of chemical control are being made, but no measure has yet given good enough results to be suitable for the ordinary African grower.

Stephanoderes

7. The Coffee Berry Borer, *Stephanoderes hampei* Ferr., has been general on both *arabica* and *robusta* coffee except at the higher altitudes. Serious outbreaks are very patchy, and the factors controlling them are complex and not fully understood. The parasites, *Prorops nasuta* Waterst and *Heterospilus Coffeicola* Schmied., have not been found in large enough quantities to be considered the dominant factor. Appreciable loss of crop takes place through the shedding of cherries attacked by the borer, while the beans are still too soft for it to breed in. Information on the amount of damage by the borer is being collected by samplings of shed coffee, of coffee on the trees and of coffee in various stages of preparation and from different areas. While this pest is seldom really bad over a large area, it causes considerable losses to the industry as a whole. Thorough picking of all ripe and over-ripe coffee would reduce these losses very much.

Berry- and Tip-Boring Caterpillars

8. *Thliptoceras octoguttalis* Feldr. (Pyrilidae) does considerable damage in the west, but less in the centre and east. Sometimes it bores into cherries and eats out the beans, but probably more loss is caused by its habit of nibbling round the bases of cherries and causing them to fall. In Bugishu the main bean borer in 1946 was *Eucosma nereidopa* Meyr. (Eucosmidae), which occurred mainly at the higher altitudes. In 1947 damage increased at the lower altitudes, and both this species and *Argyro-ploce batrachopa* Meyr. (Eucosmidae) were common. A hitherto unknown form of damage due to *E. nereidopa* is the boring and killing back of the tips of young sappy shoots, especially the leaders of young stems. This results in excessive branching and the formation of very dense bushes. So far no way of preventing this damage has been found, but it can be rectified by removal of excess shoots. A black and yellow Braconid parasite has been reared in numbers from *E. nereidopa*. *Obtusipalpis fuscipartalis* Hamps. (Pyrilidae), *Brachyacma palpigera* Wals. (Gelechiidae), *Deudoris bimaculata* Hew. (Lycaenidae) and several unidentified species contribute to loss of cherries and beans in different areas. Although the percentage loss of crop from caterpillars is small this toll of such an important crop means an appreciable financial loss to the country.

Minor Pests

9. The stemborers, *Apate* spp. (including *A. indistincta* Murr.) and *Dirphya princeps* Jord., have been found rarely, while *Bixadus sierricola* White has appeared more commonly in a few places. All records have been on *arabica*. In no instance has serious damage to the health of a tree been apparent, even when the stem was extensively bored. The last species is kept in control by routine measures twice yearly on Mt. Elgon.

10. The following five insects have usually done little severe damage but favour shaded coffee, so that they are likely to become more important, as the present policy of planting shade trees is carried out: *Epiplema doker-tyi* Warr. (Lepidoptera, Epiplemidæ), *Hopladothrips marshalli* Karny

and *Diarthrothrips coffeae* Will. (both Thysanoptera), *Lycidocoris mimeticus* R. & P. (Hemiptera, Capsidae), and *Habrochila placida* Horv. (Hemiptera, Tingidae), one outbreak of the last appeared to have been controlled by a fungus believed to be *Hirsutella citriformis*.

11. Larvae of *Epicamptoptera* (*Metadrepana*) spp. (Lepidoptera, Drepanidae) have caused local damage, which can be prevented by hand picking or lead arsenate spraying, according to circumstances.

12. There are indications that the stinging ant *Macromischoides aculeatus* Mayr. can be controlled by dusting or spraying with benzene hexachloride.

13. Other insects which have caused almost negligible damage are Coccidae including *Lecanium viride* Green, *L. hemisphaericum* Targ., *Ctenochiton arborescens* Laing and *Pseudococcus Kenyae* Le Pelley; the leaf-mining Lepidoptera, *Leucoptera* sp. (Lyonetiidae) and *Parectopa aletreuta* Meyr. (Gracilariidae); the grasshopper, *Zonoceros variegatus* L.; the weevil, *Isaniris pusillus* Hust. an Eumolip beetle, *Menius gossypii* Bryant; the longicorn bean beetle, *Sophronica ventralis* Aur.; fruitflies of the genera *Trirhrithrum* and *Ceratitis*.

14. Numerous insects have been found resting, feeding or breeding on coffee but doing no appreciable damage. Some of them are new for coffee from Uganda and all records are preserved in case any should become important in the future.

15. Mousebirds (*Colius* sp.) are an apparently unrecorded pest of *arabica* coffee, which never touch *robusta*. They remove the beans from ripe cherries, leaving the skin hanging on the tree. Locally they are quite serious.

Miscellaneous Defects of Coffee

16. In the course of estimating the effects of various coffee pests, attention has been given to the following: Berry Blister, a new malady apparently caused by a Cecidomyid midge, found locally on *arabica* in Toro; Corky Pulp Disease, an apparently unknown but widespread trouble of *robusta* cherries associated with *Stephanoderes*; shedding of cherry, largely physiological, but partly due to such insects as *Stephanoderes* and caterpillars; Cherry Split, due to unknown causes, Brown Blight due to the fungus *Colletotrichum coffeanum* Noack and two other defects of the skin of the cherry of unknown origin and recorded as Matt Streaking and Yellow Blotch; symptoms on both *arabica* and *robusta* suggestive of virus disease; a new Strap-leaf malady of *arabica*, mainly on seedlings not due to any obvious organism; Hot-and Cold Disease, which can sometimes be confused with *Antestia* damage or with the virus-like malady, and finally the effects of hail, to which a variety of defects are popularly but wrongly attributed.

A. P. G. MICHELMORE,

Entomologist.

REPORT ON KAWANDA EXPERIMENT STATION

1. Meteorological

1947.—January was much wetter than normal, and there was no marked dry season. The early rains were fairly heavy. The June-July dry season was well marked, more marked than figures would indicate as most of June rainfall fell in the first week and most of the July fall in the last week. Fair rains were received in August, September and early October but dry weather set in in the middle of October and continued till nearly the end of February.

1948.—After the exceptionally severe dry season good rains fell in late February and early March, which were succeeded by a long break from mid-March till the middle of April.

Month	RAINFALL		MEAN MAXIMUM TEMPERATURE		MEAN MINIMUM TEMPERATURE	
	12 Year Average	1947	9 Year Average	1947	9 Year Average	1947
1947—	<i>Ins.</i>		<i>°F</i>		<i>°F</i>	
January ...	2·88	4·40	84·1	82·6	59·6	60·9
February ...	2·43	1·96	84·6	81·0	60·1	61·0
March ...	4·23	3·57	83·3	81·5	60·9	61·4
April ...	6·45	6·69	80·7	80·2	62·5	62·0
May ...	5·44	4·77	79·3	79·6	61·7	62·7
June ...	2·48	3·53	79·3	80·0	59·6	60·0
July ...	2·04	2·19	78·7	78·6	58·5	60·0
August ...	3·61	2·44	79·2	78·3	59·1	57·6
September ...	4·32	5·94	81·1	80·0	59·4	59·7
October ...	3·77	2·65	82·9	83·0	60·8	60·0
November ...	4·39	1·39	81·8	84·6	61·1	61·3
December ...	3·26	1·88	82·3	83·0	59·4	60·0
TOTAL ...	44·70	41·41				
	13 Year Average	1948	10 Year Average	1948	10 Year Average	1948
1948—						
January ...	2·20	1·29	84·2	85·2	59·7	60·0
February ...	2·47	2·95	84·7	86·2	60·3	61·6
March ...	4·08	2·28	83·4	83·8	61·0	61·6

2. Labour

No difficulty was experienced during 1947 in getting sufficient labour. Introduction of an attendance bonus in the middle of the year was followed by a more regular turn out. Keeping of costs on all main farm blocks was started in January 1947. This has caused farm staff to pay more attention to economy in the use of labour, and it has been possible to cultivate a larger area with a slightly reduced staff. Every endeavour has been made to arrange work so that a regular labour force can be engaged throughout the year, and the minimum use made of casual labour. Purchase of a disc harrow, and other mechanical implements, have also led to some reduction in labour requirements.

In recent months a small gang of women has been employed. They have proved useful for certain specialised jobs, but not as efficient as had been expected at routine weeding and harvesting.

3. Main Farm—Rotations

No major changes in rotations were made during the year. The following minor changes were made:—

(i) Cassava in the fourth year of cropping on Block X had previously been intercropped with groundnuts planted about a month after the cassava. Yields have been disappointing. In 1948 groundnuts were planted at the same time as the cassava and growth has been very satisfactory.

Cassava in this shift is now planted directly the rains break in February or March. In this way a fair crop can be harvested in March–May of the following year (when food is normally scarce) and cassava be fitted into a rotation without upsetting the resting shift.

(ii) The cropping sequence on Block X is:—

1st year ...	... Early Cotton.
2nd year ...	... <i>Eleusine</i> . Legume.
3rd year ...	... Cotton.
4th year ...	... Cassava interplanted with groundnuts.

In past years the second year legume had been beans, which was followed by a four or five months' break before cotton was planted in the following year. This long break in cropping leads to rapid multiplication of lumbugu (*Digitaria scalarum*), and serves no useful purpose. In the past year beans in the second year legume shift have been replaced by groundnuts, and an additional bean crop has been inserted between the groundnuts and the following year's cotton crop. This modification has proved much more efficient.

(iii) On Block 5 the agreed rotation included maize in the 3rd year of cropping planted at a normal spacing of 3' × 1' interplanted with beans. In 1947 beans were planted directly the maize had germinated but were smothered by the maize and produced a negligible yield. In 1948 the bean crop has been omitted. It is very probable that maize has now entered permanently into the agricultural system of Buganda, and work on interplanted legumes is required.

4. Main Farm—Control of Lumbugu (*Digitaria scalarum*)

In the past at Kawanda lumbugu has been controlled by a dense cover of elephant grass during the resting period, followed by hand forking at the time of opening up. So long as the cover is really dense the amount of forking required is not large, and land can be kept reasonably clean without excessive cost.

In many cases, however, it is not possible to obtain a good cover of elephant grass, and the land is heavily infested with lumbugu at the time of opening. There can be little doubt that grazing of the resting grass period is a more economical method of use than resting under ungrazed grass.

Though lumbugu does not appear to increase rapidly when a dense stand of Rhodes grass or elephant grass is grazed, the amount of lumbugu is normally greater at the end of a grazed ley period than at the end of an ungrazed one. Forking out lumbugu when infestation is heavy requires 80 to 200 men days per acre, which is far too expensive at to-day's labour rates.

On Block *VIII* maize is the first crop following a three-year grazed ley period. In both 1947 and 1948 the first-year land field was fairly heavily infested with lumbugu. The field was ploughed with a disc plough in January and land thoroughly worked by plough and disc harrow before being planted with maize about six weeks later. The soil during this working was fairly dry. The field was hand weeded carefully directly the maize had germinated and twice again during the succeeding six weeks. By that time maize growth was sufficiently dense to prevent further growth of lumbugu. After maize had been harvested in 1947 odd patches of lumbugu were forked out, but the total cost of opening, weeding maize and the final forking was less than Shs. 100 per acre. This method of getting rid of lumbugu is sometimes used by African farmers. To be successful and cheap the following considerations must be borne in mind:—

(a) Land must be broken before the main rains start. This is normally not possible without a tractor.

(b) The crop grown must produce a dense shade. Maize or sorghum are ideal. *Eleusine* or groundnuts probably produce sufficient shade but are not easy to weed sufficiently carefully. Cotton would not be a suitable crop.

Main Farm—Treatment of Resting Land

In my report for 1946 the method of establishing elephant grass by planting sets in the ridges as sweet potatoes are harvested was described. Wherever elephant grass follows a final crop of sweet potatoes this method was used in 1947. Apart from a small area planted in January and February, 1948, in the middle of the dry season, which had to be replanted, stands obtained have been good and costs low. The same method is now being used for establishing after cassava. A small trench is dug from stool to stool as the cassava is harvested, and the elephant grass reeds covered over in continuous furrows. Where Rhodes grass follows sweet potatoes it has been sown directly after harvesting and covered by light hoeing. In some cases this has involved sowing in very dry weather, but seed has remained dormant till rain fell, and has then come quite well. The essential consideration is to get the planted or sown grass in and away before lumbugu gets a chance to establish itself.

6. Main Farm—Cropping

(a) COTTON

With the exception of one small field under B.P. 52 the main farm was sown to B.C. 66. Yields in comparison with other years are given on page 33.

Year			Acreage	Variety	Yield: Seed Cotton	Fifi	Ginning outturn
					<i>per acre</i>	<i>%</i>	
1941-42	...	...	19.8	B.P.52.B.	784	7.4	...
1942-43	...	...	20.3	B.181	965	4.2	...
1943-44	...	...	20.9	B.181	523	4.8	...
1944-45	...	...	23.1	B.P.52	508	16.6	...
1945-46	...	...	20.6	B.P.52	919	4.0	...
1946-47	...	...	24.5	B.C.66	580	18.0	32.0
1947-48	...	...	23.4	B.C.66	681	14.2	32.4

Planting started on 13th May and was completed on 13th August, the bulk of the crop being planted during the period 19th-29th July.

May sown cotton germinated well and was not adversely affected by the prolonged June-July dry spell. Two fields sown during the first week of June germinated rather poorly, but eventually gave fair yields. No planting was possible from 6th June to 19th July. A new land plot prepared for June planting, but not planted until 20th July, gave a yield of 640 lbs. per acre with very low weeding and picking costs, and gave the highest profit per acre. Cotton which follows maize was interplanted in the standing maize during the last week of July.

All cotton made good growth up till the middle of October. Subsequently little rain was received, and, with the exception of May plantings, growth was stunted but carried a fair bottom crop which was exceptionally cheap to pick. Weeding costs were also low.

(b) MAIZE. 1946-47 Season

In addition to Maratha, a long-term white, two recent selections made by the Botanical Section were taken over for increase, Kawanda No. 3, a short-term yellow, and Kawanda No. 8, a short-term white.

Owing to lack of a dry spell in 1946-47 uprooting of cotton did not take place until March in most cases and maize which followed cotton was planted in the standing cotton. Stands were only fair, and early growth etiolated. This accounts for indifferent yields in most cases.

YIELD

Field			VI. 4	VIII. 5	IX. 1	IX. 3
Previous Crop	...	...	New Land	New Land	Cotton	Cotton
Variety	...	...	Kawanda 8	Maratha	Kawanda 3	Kawanda 3
Sowing Date	...	...	21-2-47	22-2-47	28-2-47	18-3-47
Harvesting Date	...	...	10-6-47	5-8-47	6-8-47	9-9-47
Yield per acre in cob. (lb.)	...	...	3,050	4,063	3,052	2,702
Shelling Percentage	...	...	73.3	78.1	76.3	73.0
No. of cobs to 1 lb.	...	...	4.0	1.8	3.5	...
Yield per acre Grain (lb.)	...	...	2,236	3,173	2,319	1,972

Considerable quantities of Kawanda No. 3 and Kawanda No. 8 seed were distributed to Field Officers for trials in district experimental plots.

1947-48 *Season*.—Owing to the prolonged dry season, planting was rather later than had been the case in the previous year. On the other hand rains, when they broke early in March, were heavy and gave the crop a good start; this was assisted by the fact that all cotton had been uprooted some weeks before maize was planted. The long dry spell in late March and April caused premature tasseling particularly of the short-term varieties.

(c) BEANS

Yields of early rain plantings averaged about 1,000 lbs. per acre, which is about average. Mutike 4, Canadian Wonder and Banja gave the best yields. A number of recent local selections were tried, but none proved particularly promising.

Yields of second rain plantings were very poor, in most cases less than 400 lbs. per acre.

Beans were tried as an interplanted crop in sweet potatoes, maize and cotton. Owing to the very prolonged June-July dry spell yields in all cases were poor, in most cases the return hardly covered the cost of growing and seed.

Considerable quantities of seed were issued to district experimental centres and to African farmers.

(d) SOYA BEANS

Varieties received from the Botanical Section for increase were Hernon 29, Hernon 5, R. 184, and 42.S.2 (a reselection from S.42). Yields in the first rains averaged 670 lbs. per acre and in second rains 360 lbs. per acre.

Considerable quantities of seed were issued to district experimental centres, but few requests received from African farmers. In 1948 there has been a considerable demand for seed from non-native planters.

(e) SWEET POTATOES

Good yields were obtained from all plantings made up to the end of May, the average over 2.16 acres being 6.3 tons per acre, with 1 acre field giving 15 tons to the acre. Yields from plantings made from June to September (the main season for sweet potatoes) were poor, the average from 4.52 acres being 2.6 tons per acre.

Namujuna maintained its position as much the heaviest yielder of any of the standard varieties grown at Kawanda. It can normally be relied upon to give a 50% higher yield than any other variety. It is a white skinned and white fleshed variety which the Botanical Section have shown gives its maximum yield in about 180 days, but gives a very reasonable yield from 145 days onwards. It is considered reasonably palatable. A survey on the Seed Farm showed that over 80% of the sweet potatoes grown by our tenants are of this variety.

Of new types tried during the year Caroline Lea, a West Indian yellow fleshed variety which is very palatable and gives a good yield in four months has done well. It was obtained from the Tanganyika Agricultural Department on the advice of the Senior Entomologist and Mr. H. I. Manning. One unfavourable characteristic is the fact that it will not keep for long in the ground after attaining maturity. Kayulu, a local yellow flesh which

is also very palatable, introduced by Mr. Mukibi, has proved very susceptible to mosaic.

Planting material of Namujuna has been issued to a number of European and African stock farmers.

(f) **ELEUSINE**

Engenyi on Block VI. 6 yielded 2,280 lbs. unthreshed heads (1,800 lbs. grain) per acre; a Teso mixture on Block X.3 2,737 lbs. unthreshed heads (2,100 lbs. grain) per acre. In both cases germination was poor owing to insufficient consolidation of the seed bed. Some transplanting was carried out, but this proved very expensive. A Cambridge rim roller has now been purchased, which should prove very useful on Kawanda soils.

No *Eleusine* seed has been distributed. This crop is much more expensive to grow than maize with hand labour. It would appear to be a crop which is well suited to mechanical methods of drilling, weeding and harvesting and purchase of equipment for these purposes is receiving consideration.

(g) **GROUNDNUTS**

B.227 was the only variety grown in 1947 and 1948. This variety gives good yields and is easy to handle.

Yields: Lbs. Unshelled Nuts Per Acre

Field	Variety	Sowing Date	Harvesting Date	Yield	Notes
X.3.S ...	B.227	15 to 17-3-47	8- 7-48	2,041	
VI.6 ...	B.227	15- 4-47	10- 7-47	1,350	
X.6 ...	B.227	April	9- 7-47	578	Interplanted in cassava.
X.3.N. ...	B.227	16- 8-47	29-12-47	794	
VII.4 ...	B.227	6- 9-47	14- 1-48	277	Interplanted in cassava.
Mayanja					
A.1 ...	B.227	6- 9-47	6- 1-48	929	

Though yields from second rain sowings were low, they were higher than those of any other legume planted in the second rains of 1947.

Mayanja A.1 is a newly opened strip of skirt land bordering the Mayanja river. It appears to be very well suited to groundnut cultivation, and harvesting costs on it will undoubtedly be much lower than on the stickier soils on the ridge.

About 3,500 lbs. of B.227 seed were sold to local farmers during January-March, 1948. The demand is much greater than we can supply.

(h) **CASSAVA**

A summary of yields obtained from certain of the mosaic resistant types selected by the Botanical Section as being worth increasing is given in Appendix I. Nos. 8 and 11 have given consistently the best yields. No. 43 gives rather a low yield of very fibrous roots. It has the advantage that it gives an excellent soil cover and suppresses lumbugu. All these types, with others, have been included in a harvesting date and palatability trial now being run by the Botanical Section.

(i) ENGLISH POTATOES

A number of small plots were grown in swamp land, and on ordinary land. Yields in 1947 were consistently bad, blight being the main trouble. A few pounds of two blight-resistant strains were obtained from Kenya towards the end of the year; owing to dry weather it was possible to maintain seed stocks only. Kakumiro No. 2, obtained from the Assistant Agricultural Officer at Kakumiro, was also tried in the second rains, and appears to be reasonably blight resistant.

(j) PEAS

Small areas of Harrison's Glory (Marrowfat), Early Market Giant (a garden pea obtained from Messrs. Simpson and Whitelaw) and Mauritius (field pea) were grown. The Mauritius appears to have no advantages over a bean and will not be grown in the future.

In 1947 yields of peas in the second rains were in many cases higher than those of beans, over 2,000 lbs. per acre of green peas being obtained from a small plot of Early Market Giant grown on skirt swamp land. There is little doubt that garden types of pea are one of the most profitable crops in this neighbourhood.

(k) SORGHUM

Namatera was the only variety grown.

A field sown on 30th September, 1946, which had produced a first crop of 3,608 lbs. (unthreshed heads) on 25th January, 1947, was cut back after harvesting and produced a ratoon crop of 1,674 lbs. per acre in May, 1947. This plot was subsequently planted with cotton. The sorghum trash was cut and carted off for bedding and mulch, after which preparation for cotton was very cheap.

A field sown on 26th August, 1947, was harvested in January, 1948, and gave a yield of 752 lbs. per acre only. The ratoon crop is growing well and will probably be better than the first crop.

(l) SUNFLOWER

Three recently introduced varieties were grown, White Eyed, Black and Grey striped. Yields from April plantings were from 400 to 1,600 lbs. per acre, and of September plantings from 400 to 1,400 lbs.

This crop withstood the abnormally severe dry second half of the year better than almost any other crop. It is cheap to grow, and may well prove a useful crop for planting late in the year.

Surplus seed has been sent to the Western Province.

7. Urena Lobata. Germination Tests

A series of germination tests were carried out to find out:—

(a) The effect of soaking seed in hot and cold water.

(b) The effect of time of picking.

(c) The effect of length of storage time between picking and sowing.

Tests were carried out in three localities in each case on blotting paper in the laboratory, in soil boxes in the green house and in soil outside. In all cases seed was watered regularly. Duplicate samples of 100 seeds were used in each case. Seed in the husk was used, not cleaned seed. They showed:—

(i) Soaking seed in cold water for 48 hours has no beneficial effect on germination. Dipping seed in boiling water appears to have a slightly beneficial effect, but as good germination can be obtained without soaking it is not normally worth doing.

(ii) The main fruiting season of *Urena* at Kawanda is from July to September. Seed collected in September showed better germination than seed collected from October to March.

(iii) September collected seed showed good germination when sown in each month from September to March. When September collected seed was sown in September, germination in the first month was 12%, in the second month 49%. From October to January, germination in the first month was from 8 to 45%. In February and March, it was 76 and 88%, respectively. In so far as field conditions are concerned delayed germination is little better than no germination; it would appear desirable therefore to keep seed for 4-5 months between picking and sowing.

(iv) In so far as Kawanda is concerned the best procedure is therefore to pick seed from July to September and sow untreated seed in the following year. Dehusking the seed is unnecessary.

Perennial Crops

8. TEA

Kawanda has taken over distribution of tea seed from all departmental tea seed plots in Buganda. During 1947, 1,355 lbs. were sold at Shs. 2 per lb. and 100 lbs. of old seed at 50 cts., total revenue being Shs. 2,760. The demand exceeds the supply.

9. DERRIS

A plot sown in August, 1945, was harvested in April, 1948. Receipts are likely to exceed Shs. 1,500 per acre. Additional plots have been planted, as this crop appears to show a good profit.

10. CINCHONA

No additional work has been done on this crop.

11. ORCHARDS

No additional plantings have been made apart from replacements. Seed of reputed high papain strain of Pawpaw has been sown and plants are growing well.

12. NURSERIES

Nurseries have been used for observations on certain promising types of local fibre crops and vegetables. Some seed has been sold, as vegetables are a useful side industry in this area.

13. Swamp Utilisation

The Hydrological Section of the Geological Department have recently carried out a survey of newly purchased swamp land adjoining Kawanda. Their survey shows that an adequate fall exists to use any water available for irrigation. Owing to lack of rain the swamp has now been nearly dry for nearly twelve months.

About 10 acres of drained swamp have been cleared for cultivation. Observations on methods of cropping this land are being made.

The new swamp land has also been very valuable as a source of brick clay, fencing and building poles and papyrus for roofing. A sample of "Binsambwe", *Triumfetta* sp., a possible local jute substitute has been prepared. This plant is dominant in certain sections of this swamp. It is the most commonly used local fibre for tying on roofs, etc., when a fibre stronger than banana fibre is required.

14. Mechanical Cultivation

A number of different types of tractors were tried out on experiment farms and on African farmers' land during the year. Work has been held up in many cases by lack of suitable implements, particularly disc ploughs. The results of experience are summarised below:—

(a) Owing to difficulty in getting labour, high labour costs and seasonal nature of the main agricultural operations there is a keen demand for hire of tractors in Buganda for opening new land. This demand is spread over a very considerable part of the year, probably up to eight months. The main demand has come in the first place from large farmers who normally employ hired labour, but small farmers are prepared to consider methods of re-orientating their farms so that tractors can be used. Lack of cash to pay for hire of a tractor is seldom given as a reason for not hiring.

(b) Satisfactory cultivating, planting, inter-row weeding and harvesting equipment have not been available this year. There can be little doubt that a demand for them will arise, but they normally require larger fields for economical working than ploughs, and will require more preliminary testing and experiment.

(c) Much of the land of Buganda carries a heavy grass cover and frequently contains tree stumps and stones. Results so far have been much more satisfactory with disc ploughs than with mouldboard ploughs.

(d) The wheel type is important. Caterpillar tractors undoubtedly give the most satisfactory results in most parts of Buganda, but are difficult to move about from field to field. Pneumatic tyred tractors have not been satisfactory under wet conditions, but have given good results when fitted with wheel strakes. They have the great advantage of being easy and cheap to move about. They cannot be used on land with many tree stumps. Iron wheeled tractors do not appear to have sufficient grip to give good results on most of our soils. Half-track tractors have been tried; they do a good job, but a proper estimate of fuel consumption, etc., in transit has not yet been made.

(e) Indications obtained so far suggest that intermediate powered tractors, 20–30 h.p., will be the most satisfactory for general purposes. Higher powered tractors have a greater loss of efficiency through moving about between smallish fields and in turning at the ends. Tractors of less than 16–18 draw bar horse power are not sufficiently robust to stand up to breaking work. These light tractors may prove useful for certain specialised purposes, but to begin with a general purpose tractor is required.

(f) The greatest difficulty met with so far is the inefficiency, carelessness and idleness of African drivers. Much of this is due to insufficient training and experience. In order to get over these difficulties very high

supervision costs are to be expected at the inception of any mechanical cultivation scheme. Provided these difficulties are overcome results obtained so far suggest that tractors can be run at costs not much higher than costs met with in European countries.

(g) *Soil Conservation*.—Plots laid out on the contour by eye have been used so far. A maximum strip width of 30 yards with 3 yards of natural grass left between adjacent strips has been used.

Slopes greater than 8% have not been accepted for ploughing.

(h) *Prices*.—Prices graded according to the area of the field have been used. This is probably the most effective incentive to get large communal strips for cultivation.

(i) *Spare Parts*.—Tractor work has repeatedly been held up by lack of spare parts and tools. Adequate spare part and servicing arrangements from the manufacturer's agent is essential to maintain reasonable efficiency. We stock day to day spares, but cannot be expected to maintain full workshop facilities.

AGRONOMY EXPERIMENTS

15. Coffee Costings Experiment

Yields from all treatments in the 1947-48 season were high, in fact so high that differences in yield between treatments obtained in previous years are very largely masked by this year's yields. Summarised yield figures are given in Appendix II. The experiment was planted in 1941.

(a) CULTURAL TREATMENTS

(i) *Effect of shade*.—Yields under *Ficus* and *Albizzia stipulata* still remain rather lower than on unshaded plots, but the reduced yields are very largely offset by lower cultivation costs. Yields under banana shade are very low, and in this case there is no compensating reduction in costs. Yields of bananas were not high enough to make up for poor coffee yields.

(ii) *Effect of ground treatments*.—The three ground treatments included are clean weeded, elephant grass mulch and *Leucaena glauca* as a cover crop. In previous years elephant grass mulch had given higher yields than clean weeded, and clean weeded higher yields than *Leucaena* cover. Poor yields with *Leucaena* in early stages of the trial were in all probability reduced by competition between coffee trees and the cover crop. Coffee trees are now large enough to shade out *Leucaena* in their immediate vicinity, and in the 1947-48 season the cover crop plots gave at least as good yields as the other ground treatments.

(iii) *Elephant grass rows as a stop wash*.—One treatment, plot No. 13, is included with rows of elephant grass between each four rows of coffee. A comparison of yield between trees adjacent to elephant grass with those obtained from trees not adjacent has again been made. Though the average yield is higher on the "not adjacent" trees results are inconsistent and cannot be relied upon.

(b) VARIETAL TREATMENTS

(i) *Spreading and erect types*.—Spreading coffee was planted in this experiment at 15' × 15', erect coffee at 10' × 10'. In most cases rows of

temporary erect trees were planted between the widely-spaced spreading trees. There are three straight comparisons between the two types, which are extracted in Table 1.

TABLE 1
SPREADING VERSUS ERECT COFFEE
Coffee yield as percentage of mean annual yield

Cultural Treatment		1943 to 1944	1944 to 1945	1945 to 1946	1946 to 1947	1947 to 1948	Means
No shade ...	Spreading	159	315	104	109	113	133
Elephant grass mulch ...	Erect	625	394	153	330	123	193
<i>Albizzia</i> shade ...	Spreading	83	105	171	161	122	134
Clean weeded ...	Erect	170	148	208	78	136	160
<i>Albizzia</i> shade ...	Spreading	2	1	31	32	82	52
<i>Leucaena glauca</i> ground cover	Erect	23	1	100	55	141	105

From Table 1 it is clear that, though the erect coffee still gives a considerably higher yield than the spreading, the difference between the two is much less than was the case in the early stages of the experiment.

(ii) Comparisons between selections made within the spreading and erect types.

The experiment includes ten spreading selections and five erect selections. These are randomised within their respective treatments. Yields are given in Table 2.

TABLE 2
SPREADING STRAINS

Strain No.	Yield in Kgm. fresh cherry per 20 trees			Yield in lb. clean coffee per tree			Yield equivalent as lb. per acre 15' × 15'		
	1943 to 1947	1947 to 1948	1943 to 1948	1943 to 1947	1947 to 1948	1943 to 1948	1943 to 1947	1947 to 1948	1943 to 1948
203/30 ...	450	426	877	9.93	9.40	19.33	1,922	1,820	3,743
2595/56 ...	358	383	741	7.88	8.45	16.34	1,526	1,636	3,163
2573/9 ...	352	382	738	7.75	8.41	16.28	1,501	1,629	3,152
2585/24 ...	378	368	746	8.34	8.10	16.44	1,615	1,569	3,184
2575/53 ...	341	366	707	7.52	8.08	15.59	1,455	1,563	3,019
223/32 ...	373	358	731	8.21	7.90	16.12	1,590	1,530	3,120
236/26 ...	277	309	586	6.12	6.81	12.92	1,184	1,318	2,502
213/35 ...	286	292	578	6.30	6.44	12.73	1,219	1,246	2,465
234/25 ...	288	275	563	6.34	6.07	12.41	1,228	1,175	2,403
2375/12 ...	222	261	482	4.89	5.75	10.63	946	1,113	2,059
L.S.D. (20 : 1) ...	109	67	129						

ERECT ROBUSTA STRAINS

Strain No.	Yield in Kgm. fresh cherry per 30 trees			Yield in lb. clean coffee per tree			Yield equivalent was lb. clean coffee per acre (10' × 10')		
	1943 to 1947	1947 to 1948	1943 to 1948	1943 to 1947	1947 to 1948	1943 to 1948	1943 to 1947	1947 to 1948	1943 to 1948
3/71 ...	484.9	395.4	880.3	7.13	5.82	12.94	3,104	2,531	5,636
3/20 ...	433.4	313.2	746.7	6.37	4.60	10.98	2,775	2,005	4,781
1/15 ...	393.3	333.7	727.0	5.68	4.91	10.69	2,518	2,136	4,654
2/13 ...	393.0	329.2	722.2	5.78	4.84	10.62	2,516	2,108	4,624
1 2 ...	360.5	277.6	638.1	5.30	4.08	9.38	2,308	1,777	4,085
L.S.D. (20 : 1) ...	56.7	56.6	102.4						

NOTE.—Yield of fresh cherry as recorded from the field. Yield of clean coffee calculated from the cherry weights using a uniform conversion figure throughout of 5 : 1. No allowance made for possible different conversion figures with different strains.

From the figures given in Table 2 it is clear that there are large and consistent differences between strains. A more careful analysis of these figures will undoubtedly show up differential responses on the part of strains to age and to cultural treatments.

(c) *Manurial Treatments*.—Half of each plot in this experiment has been manured with 10 tons per acre of cotton seed in each of the years 1944 to 1947. Comparative yields in 1947-48 of the manured and unmanured halves are given in Table 3. It should be noted that treatments in this case are not randomised. Cotton seed has been applied to the eastern half of each plot. Responses in the 1947-48 season have been larger than in previous years, and there is little doubt that manuring has in fact given a positive response. Owing to the difficulty of interpreting results without proper randomisation, and the fact that manuring coffee with cotton seed is not now a practicable proposition nor likely to be practicable in the future, this treatment has now been abandoned. Alternative randomised manurial treatments will be substituted for it.

TABLE 3
Yields in Kgm. Fresh Cherry Per Plot. 1947-48 Season

Plot. No.			Cotton Seed	No. Cotton Seed
1	...	...	2,639	2,436
2	...	...	1,708	1,155
3	...	...	3,188	1,395
4	...	...	1,378	926
5	...	...	829	656
6	...	...	467	307
7	...	...	1,395	1,132
8	...	...	1,919	1,852
9	...	...	2,468	2,085
10	...	...	2,710	2,389
11	...	...	1,506	1,562
12	...	...	2,723	2,538
13	...	...	2,490	1,368

Cotton seed appears to have had the least benefit on plots 1, 11, and 12 which have a *Leucaena glauca* ground cover.

16. Continuous Cultivation Experiment—Block V

This experiment was started early in 1947.

Main treatments are:—

- A. Continuous cultivation with no manure.
- B. Continuous cultivation with 10 tons farmyard manure once in three years.
- C. Continuous cultivation with fertilizers (Rock Phosphate at 4 cwt. per acre and Sulphate of ammonia at 2 cwt. per acre) applied once in three years.
- D. Alternate cultivation, 3 years' cropping followed by three years' resting under *Chloris*. No manure.

Effects of treatments have not yet had time to show up.

GRAZING AND GRASS TESTING

17. Grass Collection

This has been maintained and a few additions made.

18. Elephant Grass and Chloris

NO-LIGHT-HEAVY GRAZING TRIAL

An experiment has been laid out on Block II, Strip 7 to determine the relative value of these two species for grazing and as restorers of soil fertility. Both liveweight gains of cattle grazed on the experiment and residual fertility expressed as crop yields will be measured. In the first six months of the trial differences in liveweight gains on the two species were negligible.

19. Elephant Grass Rows

Records of yields on twelve unreplicated elephant grass strains were continued. These rows were planted in 1943.

Yield's 1,000's lb. Green Material per Acre

Strain			1 Cut 1943	1 Cut 1944	1 Cut 1945	2 Cuts 1946	4 Cuts 1947	TOTAL 1943-47
1	...	...	12	38	27	62	48	187
2	...	...	21	47	47	51	54	220
3	...	...	25	51	44	73	56	249
4	...	...	18	42	30	49	46	185
5	...	...	24	48	47	83	45	247
6	...	...	14	48	44	49	50	205
7	...	...	14	44	38	88	60	244
8	...	...	8	35	35	53	48	179
9	...	...	19	51	33	61	56	220
10	...	...	27	58	41	43	64	233
11	...	...	8	36	37	47	54	182
12	...	...	11	42	35	43	49	180
MEAN			17	45	36	58	53	211

These plots were manured in January, 1947.

20. Grazing Observation—Plots—Block II, Strip 9

These plots were planted in 1945. Grazing was carried out in the 1946-47 and 1947-48 seasons. At the time of ploughing up in April, 1948, records were kept of weight of couch (*Digitaria scalarum*) forked out per plot. Grazing day and couch records are given in Table 6.

TABLE 6

Grass Species	GRAZING DAYS PER PLOT			Grazing Days per acre (Total)	Weight of couch roots (lb.) per acre)
	1946-47	1947-48	Total		
Kavirondo Sorghum ...	217	267	484	1,210	1,445
Elephant grass ...	227	290	517	1,290	2,125
<i>Paspalum notatum</i> ...	210	329	539	1,350	425
<i>Setaria sphacelata</i> ...	234	263	497	1,240	2,770
<i>Eremochloa ophiuroides</i> ...	224	315	539	1,350	12,070
<i>Echinochloa pyramidalis</i> ...	253	295	548	1,370	2,990
Natural Regeneration ...	235	335	470	1,170	510
<i>Cynodon plectostachyum</i> ...	266	414	680	1,700	4,845
<i>Chloris gayana</i> (Teso) ...	292	378	670	1,670	2,765
<i>Brachiaria decumbens</i> ...	206	252	458	1,140	1,040

Grazing days recorded are for about half a day in each case, and should be divided by two to represent true grazing days. The only points worth noting are:

(i) The high grazing figures obtained for both *Cynodon* and *Chloris*, both of which were in fairly pure stand throughout.

(ii) The low grazing value of *Brachiaria decumbens* and natural regeneration.

(iii) The low Couch (*Digitaria scalarum*) figure given by *Paspalum notatum*. There is little doubt that this grass gives a better control of couch when grazed than almost any other grass species tried here. Figures are not very reliable, and infestation naturally depends upon amount present at the start of the trial.

21. Grass Observation Plots—Elephant Grass and Chloris

Observation plots were laid down on Block I in October, 1947, to obtain preliminary observations on the following points.

(i) Yields under cutting and grazing of three promising elephant grass strains compared with *Chloris* and a mixture of elephant grass and *Chloris*.

(ii) The persistence of elephant grass when allowed to mature and then cut back before grazing or cutting is started compared with its persistence when cut or grazed from the start.

One preliminary observation worth noting is that *Chloris* will not grow under tall elephant grass, though it has done well under elephant grass cut back from the start.

22. Grazing Observation-Plots General

Observation plots on Block IV have confirmed previous evidence that Kavirondo sorghum will not stand up to grazing for more than eighteen months at Kawanda. Trials with this grass for grazing have been discontinued.

Excellent stands of *Chloris* have been obtained in numerous observation plots. These have all been of the Teso strain. Considerable quantities of seed have been issued to experimental plots elsewhere in Buganda, and to African and European farmers. A few cases of poor germination have been reported, but this species appears to be very promising.

The following species from the grass collection were included in preliminary grazing trials started in October, 1947, and some notes are worth including.

<i>Bothriochloa insculpta</i>	...	Grew well from seed. Excellent cover. Seed expensive to collect. Good grazing.
<i>Brachiaria brizantha</i>	...	Poor germination, but good cover obtained after 7-8 months. Good grazing.
<i>Chrysopogon aucheri</i> ...	...	Seed did not germinate.
<i>Stylosanthes guinenses</i>	...	Good cover. Grazing not yet started.
<i>Pueraria phaseoloides</i>	...	Makes a good cover in time. Grazing not yet started.
<i>Hyparrhenia rufa</i> ...	...	Rapid germination and fair cover. Very popular as a grazing grass, but good sward not yet achieved at Kawanda.
<i>Echinochloa</i> sp. (Lango)	...	A relatively fine strain. Very rapid germination. Apparently palatable, but rather tufted growth.
<i>Pennisetum pedicellata</i>	...	(from Nigeria). Similar to <i>Pennisetum polystachyum</i> , but less promising. Not worth growing.
<i>Paspalum notatum</i> ...	...	Fair stand from seed after 8 months. Better results should be obtained by seed treatment, which has not so far proved successful at Kawanda.
<i>Themeda triandra</i> ...	...	Seed did not germinate.
<i>Melinis minutifolia</i> ...	...	This species has grown rapidly, but does not appear to provide as much grazing as a number of other species.
<i>Cenchrus ciliaris</i> ...	...	Rapid growth, but growth appears coarse under Kawanda conditions and ground cover is not good.

23. Manurial Experiments—Elephant Grass and *Chloris gayana*

A trial was laid down in February, 1948, to determine the effect on yields of elephant grass and *Chloris* of manuring with (a) Farmyard Manure, (b) Rock Phosphate, (c) Farmyard Manure and Rock Phosphate.

24. Elephant Grass—Spacing and Time of Cutting

A trial was laid down in February, 1948, to determine the effect of four different cutting intervals and three spacings.

25. Livestock—Cattle—Stall Feeding Trials

Comparisons between the liveweight gains of cattle completely stalled with grazed bullocks receiving similar concentrate rations were continued. The treatments compared are cattle obtaining their roughage ration as cut elephant grass with cattle getting their roughage ration as grazing. Three trials have now been completed and results are summarised below.

	MEAN GAIN PER DAY (LB.) IN 1ST 10 WEEKS				MEAN GAIN PER DAY IN 1ST 20 WEEKS			
	1st trial	2nd trial	3rd trial	Mean	1st trial	2nd trial	3rd trial	Mean
Stall Fed ...	0.66	0.67	0.84	0.72	0.67	0.82	0.85	0.77
Grazed ...	0.79	0.58	0.81	0.72	0.76	0.67	0.85	0.76

Experimental animals were six steers in each group in the 1st and 2nd trial, and five in the third. The results confirm that there is no great difference between the two methods of feeding. Choice between the two should be decided by economic considerations such as availability of grazing land and its value, availability of cut grass, numbers kept, value of farmyard manure produced, etc.

26. Livestock Cattle—Feeding Value of Coffee Pulp and Coffee Husk

As a result of work carried out recently in Central and South America attention has been focussed on the possible feeding value of coffee pulp and coffee husk. Trials have been initiated, but have not yet been carried to a stage where conclusive results can be drawn from them. Trials have been carried out in collaboration with the Senior Chemist, who has analysed the materials used.

COFFEE PULP

One trial was carried out with a bunch of bullocks, half given normal rations and half given wet drained coffee pulp in addition. There was no significant difference in liveweight gains between the two. The pulp was eaten readily when not mouldy. No additional work has been done on pulp as husk is produced in much larger quantities in this country, is available at all times, is easy to transport and requires no processing. Should husk prove of little value it will be desirable to start additional work on pulp, which will include methods of drying it economically.

COFFEE (KIBOKO) HUSK

Preliminary observations showed that our cattle will eat husk fairly readily, particularly when it is mixed with a little molasses (which is a cheap food anywhere near the sugar factories). The cow herd has been fed with coffee husk instead of cassava as a part of their maintenance ration for the past five months, with no noticeable detrimental effect on milk yields.

A trial was carried out from February to April, 1948, to compare the value of coffee husk, kibbled maize and raw sweet potatoes as a feed for young steers of about 250 lbs. liveweight. The basic ration was 2 lbs. cotton

seed, $\frac{1}{4}$ lb. molasses and access to a mineral lick. Mean liveweight gains over a 12-week experimental period with the following additional feeds were:—

A.	2 lbs. kibbled maize	... 1.13 lbs. per day
B.	7 lbs. Sweet potatoes	... 1.03 lbs. per day
C.	2 lbs. Coffee husk	... 0.82 lbs. per day

Treatments A and B are significantly higher than treatment C ($P\ 0.01$) but the difference between A and B is not significant.

This experiment shows that under our conditions coffee husk is not as valuable a feed as kibbled maize or sweet potatoes, which was the main point tested (the American work had suggested that dried pulp—not necessarily dried husk—is of equal value pound for pound as kibbled maize). With considerable quantities of cotton seed being used and unrestricted grazing the experiment does not show whether or not husk is of any value, gains of 0.82 lb. per day might possibly be obtained without additional supplements. Another trial has now been started including a control treatment with no additional supplements. Preliminary results suggest that gains with coffee husk will be higher than control, but not as high as with either maize or sweet potatoes. The bullocks do not clear up the pulp as well as the other feeds, so there is little chance of improving gains by feeding at higher rates. It appears probable that this food contains an excessively high fibre content for feeding as the main carbohydrate supply in concentrated feed; it is likely to be of maximum value when fed with other carbohydrate foods of low fibre content. Investigations will be continued.

27. Livestock—Cattle—Use of Root Crops as a main Constituent of Production Rations

The practice in past years at Kawanda has been to use cotton seed and oil cakes as the main supplements fed to dairy cows, on the assumption that shortage of protein normally limits production. No work on the feeding value of locally produced feeding stuffs has been done, but the results of recent work done by Dr. Griffith suggest that both young elephant grass and sweet potato tops should be regarded primarily as protein foods, hardly as protein concentrates as the very high moisture content of these feeds means that the intake of protein may be limited by the bulk they can eat.

Milk yields of our cows had been consistently disappointing from the opening of the herd up to the middle of 1947. Local stock owners suggested that feeding root crops such as cassava and sweet potatoes would increase yields, implying that yields are limited by digestible carbohydrate, not protein. Early in 1947 empirical trials were started, and results have been very promising, particularly in the case of Nganda type cows.

28. Livestock—Cattle—General

(a) HERD NUMBERS

NUMBER IN HERD ON 30TH JUNE

	1943	1944	1945	1946	1947	1948
Herd bulls	1	1	1	2	3	4
Oxen and young male stock ...	6	6	6	35	41	47
Cows	7	13	25	31	44	43
Heifers	9	15	11	22	14	18
Unweaned calves	6	21	34	30	22	24
TOTAL	29	56	77	120	124	136

(b) BREEDING, SELECTION AND MILK PRODUCTION

Three herds have been maintained during the year. Two Nganda type bulls with Nganda type cows; one Nkedi type bull from Ngetta with Nkedi type cows.

The herd has now been going just long enough for sufficient home produced heifers to come into milk to give a progeny test of our bulls. Of five heifers by Thomas I (No. 8), the first herd bull, four are definitely better milkers than their dams and the fourth not worse. This bull unfortunately died, but he is the sire of one bull now in use, Thomas II (No. 10). Of four heifers by Lukwago (No. 9) two are definitely poorer milkers than their dams, and the other two doubtful. He unfortunately is the sire of 22 heifers now in the herd. This emphasises the undesirability of using an unproven bull for too long in the herd. A policy has now been adopted of endeavouring to get about 20 calves by as many bulls as possible, and then not using them until a progeny test is obtained. Owing to late breeding of Zebu stock this policy is not as easy to follow as it would be with European stock. In these circumstances it is necessary to take more notice of ancestry than would be desirable were progeny test results more readily available.

A policy of rigorous culling of cows has been continued. In my report for 1946-47 the figure of 75 gallons was given as a minimum for retention in the herd. It has now been possible to raise this figure to 100 gallons for cows with suckled calves and 140 gallons for milked out cows. It should be possible to raise this from 100 to 150 gallons within the next year or two. Improvements so far attained have been obtained very largely by better feeding and management, not the benefits of selection.

The foundation stock of the Kawanda herd consisted of 43 cows and heifers. These have now all calved, or attained an age when they should have calved. 26 have been retained as having given 100 gallons, or likely to give it; 17 have been culled. Thirteen were bought from one Kyagwe herd and 10 retained; whereas of five bought from another herd four have been culled. These results emphasise the desirability of going for good herds, rather than good looking individuals within an indifferent herd, when setting up a new herd.

Milk Yields.—A summary of milk yields obtained in the past 18 months is given in Tables 4 and 5.

TABLE 4
MILK YIELDS

Month	1947				1948			
	Cows in Milk	Cow Milk days	Total Pro-duction	Yield per cow milk day	Cows in Milk	Cow Milk days	Total Pro-duction	Yield per cow milk day
	No.	No.	Gals.	Gals.	No.	No.	Gals.	Gals.
January ...	24	712	247	0·35	28	749	438	0·59
February ...	26	687	258	0·38	27	707	367	0·52
March ...	27	781	270	0·38	27	783	409	0·52
April ...	26	624	232	0·37	26	743	314	0·42
May ...	21	617	226	0·36	24	627	226	0·36
June ...	21	529	187	0·35	25	609	275	0·45
July ...	18	493	196	0·40				
August ...	22	512	272	2·53				
September ...	19	546	323	0·59				
October ...	24	593	356	0·60				
November ...	23	643	352	0·54				
December ...	27	721	409	0·57				

TABLE 5
LACTATION YIELDS

Yield in Lactation (Gallons)	LACTATION WHICH FINISHED IN 1947			LACTATION WHICH FINISHED IN 1948		
	No.	%	No. of cows culled	No.	%	No. of cows culled
0 to 49 gallons ...	13	52	8	10	30	7
50 to 99 gallons ...	8	32	Nil	14	41	2
100 to 149 gallons ...	4	16	Nil	8	23	Nil
Over 150 gallons ...	Nil	0	Nil	2	6	Nil
TOTAL ...	25	100	8	34	100	9

From tables 4 and 5, it is clear that a considerable increase in milk yield has been obtained. Recent results suggest that a considerably greater improvement may be anticipated in 1948. Improvement may be attributed to:—

- (i) Better feeding, particularly use of increased quantities of roots.
- (ii) "Steaming up" cows before calving.
- (iii) The effect of culling.

(c) CALF REARING

Since September, 1946, all first calf heifers have had their calves removed at birth, the cow being milked out and calves pail-fed. From the start of this scheme to 30th June, 1948, fifteen heifers have calved; twelve of them have let their milk down satisfactorily and three failed.

Pail-fed calves have suffered more frequently from scour than suckled calves, and losses among them have been slightly greater; insufficient care in sterilising utensils is probably the main cause.

With milk worth Shs. 2 or more per gallon it is clearly desirable to reduce milk consumption by calves to a minimum. Use of separated milk

is not a large economy as butter prices are much lower per gallon of liquid milk used than liquid milk prices. Attention has been paid to use of alternative feeds for calves, but the quantity of liquid milk used per cow has not yet been reduced below about 40 gallons. Processed milk products are not available at competitive prices. A few local farmers are considering trying hand rearing of calves; it is too early to tell what success they will obtain, but it is almost certainly preferable to suckling in a dairy herd where regular deliveries of milk can demand a premium.

(d) BUTTER FAT TESTING

A Gerber's testing set was borrowed from the Veterinary Department in February, 1948. With the assistance of the Chemical Section testing has been carried out once per month since then on the milk of all cows in milk. The difference in butter fat percentage between suckled and milked out cows is very large.

Month					COWS WITH SUCKLED CALVES		COWS WITH PAIL-FED CALVES	
					Number	Fat (Mean)	Number	Fat (Mean)
						%		%
1948—								
February	...	...	...	...	14	4.0	10	6.6
March	...	...	...	...	14	4.6	11	7.3
April	...	...	...	...	15	4.8	10	7.4
May	...	...	...	...	14	5.6	5	7.8

(e) BUILDINGS

No new buildings have been put up during the year.

(f) HEALTH

The health of the herd has been good throughout the year. Spraying with Gamatox was started in September, 1947, and has caused a considerable reduction in tick infestation. There is no sign of spraying causing calves not to get East Coast Fever, though some reduction in the severity of attacks is possible. Scour is now probably a more serious disease among our calves than East Coast Fever. Thirty-three calves were born during the year and three died.

(g) LIVWEIGHT RECORDS: GENERAL.

A weighbridge was received at Kawanda in September, 1946, and the current season was the first in which full records have been kept. The Husbandry Committee has arranged for a uniform system of recording to be adopted at all stations in Uganda, which facilitates comparisons between the different herds. The season used at each station is 1st April to 31st March. Cumulative gains in different sections of the herd over this period were as follows:—

LIVEWEIGHT GAINS LB. CUMULATIVE GAIN 1947/48

Herd				Cumulative Gain		Mean gain per day	
				lbs.		lbs.	
Unweaned	...	...	...	231	...	...	0.63
Weaner steers (10-20 months)	...	...	...	205	...	...	0.56
Weaner heifers (")	...	...	...	208	...	...	0.57
Young bullocks (20-50 months)	...	...	...	273	...	...	0.75
Young cows (in-calvers and 1st and 2nd calf heifers)	...	...	...	135	...	...	0.37

All gains are good as average figures. If they can be repeated consistently the implication is that average weights of bullocks under these systems of feeding should be approximately 270 lbs. at 12 months, 475 at 24 months, 680 at 36 months and 850-900 lbs. at 48 months. We have not yet had sufficient bullocks attain these ages to give an average figure; the figures merely indicate that such figures will be attained if the liveweight gains achieved in 1947-48 are maintained. The question of the best method of utilising young steers in relation to available grazing and food supplies is now receiving consideration by the Veterinary Department and the Husbandry committee. Gains from bullocks fed almost entirely on grass will be much less than those attained by our bullocks, which receive relatively heavy concentrate rations; judging from Serere experience grass fed bullocks gains will be not more than two thirds of those listed above. The choice between the two methods of rearing will depend very largely on locality; utilisation of range grazing areas for store bullocks may well prove the cheapest method of producing beef.

(h) LIVEWEIGHT RECORDS: PAIL-FED AND SUCKLED CALVES

Comparative figures for pail-fed and suckled calves during the 1947-48 season are given below:—

CALVES BORN IN 1947. AVERAGE WEIGHTS IN LB.

Months		NUMBER OF CALVES		WEIGHTS		LIVEWEIGHT GAIN	
		Suckled	Pail-fed	Suckled	Pail-fed	Suckled	Pail-fed
Birth	...	24	9	41	38		
1 Month	...	22	9	61	51	20	13
2 Months	...	21	9	77	70	16	19
3 "	...	19	7	94	88	17	18
4 "	...	17	7	112	106	18	18
5 "	...	15	7	132	123	20	17
6 "	...	14	6	156	137	24	14
7 "	...	12	4	180	152	24	15
8 "	...	8	3	203	168	23	16

The higher birth weight of the suckled calves is due to a higher percentage of first calf heifers among pail-feds. The figures show:—

(i) Suckled calves do better in the first month.

(ii) Pail-feds do slightly better in the 2nd and 3rd months.

(iii) From 6th to 8th months suckled calves do better than pail-feds.

This is not surprising, as they are getting the same supplementary ration as the pail-feds plus some milk.

At both Serere and Entebbe pail-fed calves have done better than suckled, but conditions are not comparable. Kawanda suckled calves have done much better than elsewhere, presumably owing to greater use of supplementary food.

29. Livestock—Pigs

Throughout 1947 results obtained from our pigs were most disappointing. Litters were small, most of the sows had little milk and young pigs made very poor growth. It is believed that the main reasons for poor success were inbreeding and high worm infestation.

In September a pedigree Large White boar was obtained who is being bred on to our Large Blacks. At the same time sows were moved at farrowing time from permanent quarters to movable houses in another area. Recent results have been much more promising. Both movable houses with tethered sows and movable houses with hurdles have been tried.

Our experience suggests that keeping of any considerable number of pigs in permanent quarters in this country is by no means easy, and use of movable houses is likely to be cheaper and more satisfactory. Live-weight gains of one or two litters fed very largely on sweet potatoes and maize have approached figures expected in Europe, but there can be little doubt that lack of animal protein normally limits growth rates.

30. Livestock—Poultry

A flock of Rhode Island Reds has been kept. A ready market for all sitting eggs and cockerels produced has been found. Laying records have been poor. Excessive feeding has been one cause.

31. Ngogwe Livestock Improvement Scheme

The Ngogwe Livestock Improvement area is designed as a selected area for testing out improved methods of livestock management under African farming conditions. It should be considered as an extension of experimental farms to African farming conditions. The programme of the Scheme has been drawn up by local members of the Agricultural and Veterinary departments with the advice of the Husbandry Committee. Main lines of work followed up by the agricultural staff during the past year may be summarised as follows:—

GRAZING MANAGEMENT

Surveys of a small number of farms have been made to determine the amount of grazing land available for each stock owner, and their type.

Seed of *Chloris gayana* (Teso strain) has been distributed to four farmers who are running small experiments on their land to compare this grass with elephant grass and other local species.

Four farmers in Ngogwe have purchased barbed wire for making paddocks. Their main interest is reduction of labour costs. Considerably greater interest was taken by farmers in other parts of Buganda in barbed wire and approximately 30,000 yards of ex-military wire was purchased by them in 1947. Departmental staff assisted with marking out, and showed them how to put the wire up. Barbed wire on *Ficus* or nkoma (Phoenix Palm) poles was used in nearly all cases.

Two farmers have improved their grazing lands by digging out and burning *Cymbopogon afronardus*, a useless tufted grass. One man has improved 18 acres in this way.

USE OF FARMYARD MANURE

The use of farmyard manure is becoming increasingly popular at Ngogwe. Nearly all stock farmers who have manure available are now using it for application to their banana gardens. Very few farmers use bedding, the majority being applied as fresh dung spread on the surface of the banana garden. Responses by bananas to this treatment have been very striking. One hundred and thirty ex-military wheelbarrows were obtained for resale to farmers to assist with manuring and all have been sold including 30 at Ngogwe. The wheelbarrow is probably the most suitable vehicle for transport in banana gardens.

FEEDING OF LIVESTOCK

The Ngogwe farmers' association bought 15 tons of cotton seed for its members in 1947 for stock feed. A little sim-sim cake was purchased but this has not proved popular. The association has also bought cattle salt on behalf of its members.

The majority of the stock farmers of the Improvement Area (of whom there are about 400) now feed supplements of some sort to their cattle. Banana peelings and cassava are the most popular feeds for adult cattle; cut elephant grass for calves.

MECHANICAL CULTIVATION

In view of the close supervision obtaining at Ngogwe this was considered a suitable area for trying out tractors under African farming conditions. A Fordson pneumatic-tyred tractor went down there to start work in December, 1947. An active demand for hiring the tractor was met with.

KAGONGO PASTURE SUB-STATION

Most of the Ngogwe Livestock Area is poor *Cymbopogon* grazing on the hills with good soil carrying elephant grass or forest in the valleys. As no experimental station in Uganda carries any considerable area of *Cymbopogon* grazing a pasture sub-station has been opened at Kagongo to find out how this type of land can best be farmed.

The soil is known to be of low fertility and emphasis has been placed on determining how grazing can be improved by cropping or other treatments.

Work was started in March, 1947, and attention paid in the first year mainly to opening up access roads and building houses for staff and stock.

A series of paddocks were laid out to compare the following main treatments.

- (i) Improvement of uncultivated grazing by control of fire.
- (ii) Removal of *Cymbopogon* and burning of the tufts, followed by heavy grazing.
- (iii) Cropping for one crop season followed by reseedling with Rhodes grass or natural regeneration.

(iv) Cropping for two crop seasons followed by reseeding with Rhodes grass or natural regeneration.

The trials have not been going long enough to produce useful results, but it is becoming clear that this soil will produce rather better crops than had at first been anticipated. After *Cymbopogon* has been removed an excellent stand of *Brachiaria decumbens*, *Cynodon*, *Panicum maximum* and other valuable species can be obtained provided sufficiently intensive grazing can be applied; such an intensity is difficult to attain without fencing.

A herd is being built up at Kagongo by buying heifers from some of the best milk herds of the neighbourhood.

The pasture Sub-station is also being used as the centre for the activities of the tractor unit, and for other activities of our staff in the neighbourhood.

32. Kawanda Seed Farm

COTTON

Kawanda Seed Farm is the first stage of increase of improved cotton varieties. B.C.66 was grown in the 1947/48 season.

Planting was distributed as follows:—May, Nil; June, Nil; July, 68 acres; August, 87 acres; September, 9 acres; Total, 188 acres. As will be observed most of the crop was very late sown. The average spacing adopted was 3' × 1' 6".

Owing to late planting the bulk of the crop made very poor growth and was severely checked by dry weather which set in from October onwards.

Purchases were 47,625 lbs. Safi and 466 lbs. Fifi, giving a yield of 256 lbs. per acre only. The 47,625 lbs. of Safi cotton produced 15,476 lbs. lint, a ginning outturn of 32.5%.

OTHER CROPS

A summary of first rains food crop plantings is given below (in acres):—

Crop		1944	1945	1947	1948	Remarks
Sweet Potatoes	...	62	24	20	28	
Cassava	...	50	50	3	9	
Groundnuts	...	10	7	7	12	
Maize	...	25	8	15	22	
Beans	...	21	13	12	26	
Sorghum	...	3	0	1	12	
Black gram	...	1	1	3	20	
Soya Bean	...	25	16	0	0	
Finger millet	...	3	0	0	1	
Mixed Crops	...	0	0	5	18	
Vegetables	...	5	3	2	6	Mostly beans and maize. Tomatoes, Cucumbers, Onions, Cabbages, Carrot, Peas and egg plant.

The figures are not particularly reliable, but certain trends are of interest.

(i) It is obvious that the main factor governing annual crops grown in this area is price. People rely for their food on bananas, beans, sweet potatoes and cassava. Other crops grown are very variable, and depend very largely on prices in local markets, not export markets.

(ii) Soya beans have dropped out of the picture in recent years.

(iii) The big increase in sorghum and black gram are due to very high prices paid outside controls.

(iv) Maize acreages have remained fairly steady.

MECHANICAL CULTIVATION

About 10 acres of tenants' land were ploughed by our tractor in 1947. Farmers were very pleased with results, but this area is not suitable for such work. Individual owners' holdings are too small, and most of them part-time farmers depend for their livelihood on paid employment on Kawanda or Kampala, and consequently are unwilling to combine holdings to obtain the benefits of tractor work.

LIVESTOCK

In October, 1947, three farmers on our Crown Land and five others in the Segregated area owned cattle, the total cattle population being 98. Eight men owned pigs, the total population being 13. Two farmers are taking a real interest in livestock and managing them along sound lines.

TREATMENT OF RESTING LAND

In part of the seed farm a 3/3 rotation is compulsory for tenants. In the past a considerable amount of assistance has been given planting up resting areas. This custom has been stopped. One tenant has sown two acres of resting land with Rhodes Grass and has obtained an excellent stand, with which he is very pleased. Others are interested.

R. K. KERKHAM,
Agricultural Officer in Charge, Kawanda.

Appendix I.

CASSAVA YIELDS—MOSAIC RESISTANT VARIETIES

Yields Tons of Roots per Acre

Year				1945-46	1946-47	1947-48
Field ...	...	...	X.2	X.4	X.6	
Varieties—						
No. 7	...	...	3.9	4.2	4.8	
No. 8	...	...	7.7	9.9	5.9	
No.11	...	...	6.8	7.4	6.2	
No.13	...	...	4.4	3.7	3.0	
No.43	...	...	4.3	5.3	2.4	

COFFEE COSTINGS.

Plot size is 1.03 Acre. All figures expressed per Acre.

Plot No.	Treatment	Coffee yield clean coffee lbs. per acre		Coffee yield as percentage of mean annual yield					Value of Bananas		Value of Coffee		Total Value of Produce		Cultivation Costs (men-days)	
		1947-48	1943-48	1943-44	1944-45	1945-46	1946-47	1947-48	1947-48	1943-48	1947-48	1943-48	1947-48	1943-48	1947-48	1943-48
1 ...	Spreading coffee; <i>Leucaena glauca</i> cover; No shade	2,173	2,845	14	5	65	13	136	Shs. ...	Shs. ...	Shs. 826	Shs. 1,039	Shs. 826	Shs. 1,039	90	1,089
2 ...	Spreading coffee; Elephant grass mulch; No shade	1,807	4,177	159	315	104	109	113	...	...	687	2,004	687	2,004	76	1,084
3 ...	Erect coffee; Elephant grass mulch; No shade	1,962	6,057	625	394	153	330	123	...	...	746	2,288	746	2,288	79	1,148
4 ...	Spreading coffee; Trees at 15' x 15'; Banana shade	986	1,572	13	2	57	18	62	...	...	375	554	396	707	70	892
5 ...	Spreading coffee; Trees at 20' x 20'; Banana shade	636	959	3	0	29	49	40	31	199	242	339	273	538	49	813
6 ...	Spreading coffee; Trees at 20' x 20'; Bananas 10' x 10' with Ficus top shade	332	497	0	0	15	25	31	29	222	126	189	155	411	60	839
7 ...	Spreading Coffee; Elephant grass mulch; <i>Ficus</i> shade	1,375	3,471	98	176	127	181	86	...	...	523	1,541	523	1,541	46	1,166
8 ...	Spreading coffee; Clean weeded; <i>Ficus</i> shade	2,181	4,221	107	132	140	115	136	...	...	829	1,726	829	1,726	22	769
9 ...	Spreading coffee; Clean weeded; <i>Albizia stipulata</i> shade	1,949	4,195	83	105	171	161	122	...	...	741	1,488	741	1,488	20	825
10 ...	Erect coffee; Clean weeded <i>Albizia stipulata</i> shade	2,183	5,002	170	148	208	78	136	...	...	830	1,893	830	1,893	19	634
11 ...	Spreading coffee; <i>Leucaena glauca</i> cover; <i>Albizia stipulata</i> shade	1,314	1,634	2	1	31	32	82	...	...	499	598	499	598	59	988
12 ...	Erect coffee; <i>Leucaena glauca</i> cover; <i>Albizia stipulata</i> shade	2,252	3,296	23	1	100	55	141	...	...	856	1,181	856	1,181	50	960
13 ...	Spreading coffee; Elephant grass rows; <i>Ficus</i> shade	1,632	2,799	3	22	100	143	103	...	...	628	999	628	999	34	807
	MEAN	1,600	3,133	100	100	100	100	100	...	...	608	1,218	615	1,262	52	931

N.B.—Coffee valued at current market rates in each year.

REPORT ON SERERE EXPERIMENT STATION

1. Meteorological

Month	RAINFALL		MEAN MAXIMUM TEMPERATURE		MEAN MINIMUM TEMPERATURE	
	Average 1921-1947	1947	1942-1946	1947	1942-1946	1947
	<i>inches</i>	<i>inches</i>	<i>°F</i>	<i>°F</i>	<i>°F</i>	<i>°F</i>
January ...	0.85	2.56	91.5	88.8	64.1	64.3
February ...	2.37	2.46	91.9	89.3	65.1	64.8
March ...	3.58	4.16	90.0	85.0	65.6	65.0
April ...	8.10	11.91	86.4	84.5	64.9	64.6
May ...	7.25	4.86	83.2	84.5	64.6	64.6
June ...	4.33	2.40	82.8	83.5	64.1	64.0
July ...	4.54	4.67	81.3	80.9	63.8	63.8
August ...	6.57	3.61	81.2	81.9	62.4	63.6
September ...	5.96	5.20	83.6	84.0	63.3	63.9
October ...	4.19	0.77	86.5	87.6	64.4	64.3
November ...	3.88	0.10	88.0	90.9	64.0	64.7
December ...	2.03	2.55	89.6	88.5	63.9	64.3
TOTAL ...	53.65	42.25				

1948	<i>Inches</i>
January ...	0.31
February ...	2.46
March ...	1.30

The total rainfall for the calendar year of 1947 was 8.40 inches below the average for the last twenty-six years but it was well distributed in the early planting season. The late planting season suffered from lack of rain which made the planting of cotton after mid-June very difficult. Only 1.20 inches fell between mid-June and mid-July although the total for the two months was 7.07 inches. The dry season was drier and of longer duration than usual. The average rainfall for the months of October, November, December, January and February over the last twenty-six years is 13.32 inches, whereas for the same months during the period under review only 7.49 inches fell.

For the period April 1947 to March 1948 the monthly Mean Maximum and Mean Minimum Temperatures are similar to the averages for the period 1942-1946.

2. Experiment Farm

The cropping of the six blocks of the Experiment Farm during the year is tabulated below:—

Block No.	Cropped or Resting	Remarks
A.	... 3rd Year of Rest ...	Ploughed with Fordson and mould board plough in February, 1948. This ploughing was very successful.
B.	... 2nd Year of Rest ...	Grazed at the rate of one animal per acre, with no subsidiary feeding.
C.	... 1st Year of Rest ...	As for B.
Z.	... 3rd Year of Cropping ...	This Block has now gone down to rest and no cattle have yet been put into it. It was previously cropped with food crops.
D.	... 2nd Year of Cropping	Cassava and Sweet Potato variety observation plots.
E.	... 1st Year of Cropping ...	Cotton Experiments. The <i>Eleusine</i> Fertiliser experiments 1948 and other <i>Eleusine</i> and Sorghum observation plots were planted on February 8th and 9th, 1948.

3. Old Farm

The cropping position on the Old Farm is tabulated below:—

Block No.	Cropped or resting	Remarks
1, 7 & 10	... Resting under trees	... Blocks 1 and 7 <i>Cassia Siamea</i> and (10) Oil Palms.
2.	... Resting under elephant grass since 1933	The elephant grass has now all gone out and has been superseded by shrubs and weeds.
3, 5, 6 & 8	... Resting	... An average of 30 steers are kept on these paddocks on a deferred system of grazing.
9	... Cropped in six strips. Strip 1. Fertiliser Trial on Cotton (1947). Strips 2, 4, 5 & 6 Early Cotton (S.5302) Strip 3 Mixture of varieties of <i>Eleusine</i> .	Although all six strips are now opened up and under crops, this will not be allowed to continue. Examination of this Block after the rains will reveal whether or not this block should be cropped on a 3×3 rotation. If erosion is bad it should be reclosed.
4	... Permanent Manurial Experiment	<i>Mucuna</i> cover crop planted. There is nothing further to report.

4. Main Farm—General

During the period under review the Main Farm was cropped according to Programme. All cotton was planted by the end of July and the variety throughout was S.5302 (a blackarm resistant nucleus derived from BP 50). The yields are given at Appendix B Table 8.

This year the *Eleusine* was planted on most strips during the first week in March which is on an average about a week earlier than in 1947. Unfortunately a dry spell set in which was not broken until the 31st March, and nearly all had to be replanted. During this dry spell there was an invasion of Army Worms (*Laphygma exempta*) which ate all the grass at Serere and environs and would have eaten the *Eleusine* had it germinated. These caterpillars are last recorded as having visited Serere in 1940. It has not been possible, due to weather, to plant any further food crops within the period of this report.

All the yields for the 1947 crops are given at Appendix B.

5. Main Farm—Cropping

(i) FINGER MILLET (ELEUSINE)

It was a fair to average year and yields were average except on A1. West, where the soil is very thin. The yields are summarised at Appendix B Table 1.

(ii) SETARIA

4 varieties were grown on A6C for feeding pigs and chickens but as a result of a poor stand, probably due to the heavy rains in April and in spite of resowing twice, the crop was not worth recording.

Stocks of a number of varieties were maintained on the Experiment Farm. It is not proposed to proceed with this crop except for chicken food as there is no demand for the seed.

(iii) SORGHUM

10 acres of T.7 were grown for silage and produced an excellent crop which was sufficient to fill the large pit silo.

5 acres of T.7 grown for seeds on A6E and D1W gave only 615 lbs. per acre, but 4.65 acres on D5E yielded 1,318 lbs. per acre. Cycle IV of the Fertility Experiment gave a mean yield of 1,177 lbs. per acre. A mixed crop of *Eleusine* and sorghum on B3 of the Training Farm yielded 1,218 lbs. of *Eleusine* and 999 lbs. of sorghum per acre.

(iv) GROUNDNUTS

(a) As a result of very satisfactory rains this crop did well, although at one time it was thought that excessive vegetative growth might result in poor yields but subsequently the weather was very favourable and the yields were good for Serere.

(b) The superiority in yield of B.239 over B.227 was well demonstrated this year when there was comparatively dry weather at the time of harvesting. Even so harvesting costs were extremely heavy as the dry weather did not mitigate the difficulty of picking the nuts off the haulm. In spite of its high yielding properties B.239 has never been taken up by the growers because production is based upon a large number of small nuts, and for this reason it is proposed to concentrate on the other bunch varieties which do not have this characteristic.

(v) SESAME

Two plots each 0.63 acres were grown on C6C to maintain seed stocks but as usual yields were low, Kumam giving 216 lbs. per acre of grain as against 170 lbs. for Kamod.

Costings this year have shown that with the grain selling at 12 cents per lb. there was a net loss of Shs. 17/48 per acre. It will only pay to grow this crop for sale where an average yield of 400 lbs. per acre can be obtained.

(vi) SWEET POTATOES

The yields are summarised at Appendix B, Table 5. The dry spell from mid-June to mid-July resulted in some of the crop on Block Z being damaged by "weevil" and harvesting had to be expedited.

(vii) PEAS AND BEANS

Five varieties of Beans were grown on Block Z of the Experiment Farm. The variety Banja (ex Kawanda) gave the highest yield which was 757 lbs. per acre. The yields of the remaining varieties are summarised at Appendix B, Table 6.

(viii) TEPARY BEANS

8.40 acres on C6(E) gave a mean yield of 356 lbs. per acre.

(ix) MAIZE

2.30 acres of Sahara Yellow on Block Z gave a mean yield of 2,086 lbs. per acre.

6. Cotton

The varieties of cotton planted at Serere during the period under review were as follows:—

(a) Main Farm:—S.5302 BAR nucleus made from BP.50.

(b) Experiment Farm. N.17, B.P.50, B.181 and Blackarm Resistant selections made from them.

(c) Old Farm. S.5302.

(d) Fertility Experiment. S.4304 (a derivative of B.181).

The yields were better than was at first expected, although the later planted cotton yielded very poorly. *Lygus* damage was severe on the early planted plots but the plants outgrew the damage and yielded comparatively well. The Botanist reports that Blackarm infection was slight throughout the farm.

The cotton planted at the end of May gave the highest yields. A plot planted on the 28th May yielded 1,197 lbs. of seed cotton per acre. Plots planted on the 22nd and 23rd of May yielded 781 lbs. and 945 lbs. to the acre. The early June plantings also yielded well. The two plots planted on the 5th June yielded 976 lbs. and 628 lbs. to the acre. The July and August plantings yielded badly, the best yield being 491 lbs. per acre and the worst being 211 lbs. per acre which was planted on the 1st August. Full details of the yields are given in Appendix B, Table 8.

7. Mechanical Cultivation

The year has been the transitional period for experimentation with mechanical means of cultivation. One Fordson tractor with an Elite two furrow mould board plough has been tried without much success except on the Experiment Farm which is free from roots, etc. Latterly, however, an old ox-drawn Defiance two furrow disc plough has been resurrected and is ploughing well. An Anzani Iron horse has also been used but this implement will definitely not stand up to treatment under farm conditions in this country. The experience gained from these implements has, however, been valuable and consideration should be given to the following points:—

(a) A disc plough works better under rough conditions than a mould board plough does; but once the land has been ploughed once or twice the mould board does a better job and should not therefore be completely abandoned, but should be used where the land permits.

(b) Crews need training in the adjustment and maintenance of their implements. It is the writer's opinion that new crews should undergo a course of instruction rather than let them gain experience which has so far proved very costly, and resulted in a good deal of slovenly and careless work.

(c) The technique of ploughing under conditions of strip cropping requires careful planning. After many operations of ploughing the land in the same direction it may result in the soil shifting, and an ever widening furrow being left in the centre of the field. It is the writer's opinion that every field, however small, should be carefully marked out by a trained man, and if necessary gathered to prevent the centre furrow forming. Ploughing round and round should also be avoided where the strips are short and fairly wide, because, this method results in both ends of the field being ploughed up and down the slope. Headlands where they are ploughed up and down the slope should be cross ploughed at intervals if possible, or the furrows broken by hand labour.

For costs of tractor ploughing see paragraph 19.

(d) The details of an experiment on the depth of ploughing are given at paragraph 9.

AGRONOMY EXPERIMENTS

8. Fertiliser Trials

NITROGEN AND PHOSPHATE TRIAL ON ELEUSINE—BLOCK 9 OLD FARM, 1947

Residual Effect on Cotton 1947/48.—The layout and treatments are to be found at paragraph 19 II of the previous half-yearly report.

Cotton was planted on 28th July, 1947, and the plants were singled to one plant per hole on the 9th September. Picking started on 27th November and went on until 29th January, 1948. The plants were badly stunted due to the dry weather that set in after planting.

The treatment yields in lbs. of seed cotton per acre are tabulated below:

		P ₀		P ₁		P ₂		Means
No	...	383	...	302	...	515	...	400
N ₁	...	396	...	394	...	361	...	384
N ₂	...	444	...	391	...	406	...	414
MEANS	...	408	...	362	...	427	...	399

Key to Fertilisers:—

No=No Sulphate of Ammonia.

N₁=100 lbs. per acre of Sulphate of Ammonia.

N₂=200 lbs. per acre of Sulphate of Ammonia.

P₀=No silico phosphate.

P₁=56 lbs. per acre of Silico phosphate.

P₂=112 lbs. per acre of Silico Phosphate.

None of the treatment differences are significant.

9. Methods of Ploughing

Shaving, Deep and Normal Ploughing.—A second simple trial on depth of ploughing was carried out on C₃C Main Farm.

The treatments were as follows:—

A. Hand weed and shave with hoes.

B. Normal ploughing using the Ransomes E.C. ox plough.

C. Ploughing as deeply as possible using the Howards ox plough.

The trial was carried out on cotton planted on the 24th July. The average of the yields by treatments are as follows:—

Treatment A. 413 lbs. of seed cotton per acre.

Treatment B. 481 lbs. of seed cotton per acre.

Treatment C. 561 lbs. of seed cotton per acre.

These results are not consistent with those of the previous trial and no conclusions can be drawn from the experiments at this stage.

10. Thorn Scrub Control

GRAZING AND BURNING TRIAL, 1947

This trial was laid out during the year on the western side of the Main Farm. There are three one-acre paddocks (P.65-68). The treatments are as follows:—

Treatment No.—

- A. Early burning. Yearly. (October or November).
- B. Late burning. Yearly. (January).
- C. Late burning every three years combined with:—
 - A. No grazing.
 - B. Light and medium grazing (2 and 4 beasts for 4 days per month).
 - C. Heavy grazing. (8 beasts for 4 days per month).

OBSERVATIONS

The cattle were put into the relevant paddocks in July, 1947. The early burnt paddock was burnt on 21st October, 1947. In December, all paddocks were rested to allow a little cover to grow before the late burnings. This was necessary as there was not sufficient grass to allow for a burn at all. It was not, however, possible to carry out the burnings after all as the Army Worm referred to elsewhere, ate every bit of the grass.

The experiment continues.

II. Grazing and Grass Testing Experiments

- (i) **DROPPED VERSUS FARMYARD MANURE TRIAL.** P 1-5 AND P 11 TO 15
 This trial continues. P 11-P 15 have been harvested of the first crop of cotton, having previously been rested.

The yields of cotton by treatments are as follows:—

Treat ment No.	Plot No.	Treatment	Yield of Seed Cotton in lbs. per acre	
			P 15 1947	P 11-15 1944
E.	P.11	Day grazing only. 2 Bullocks ...	248	390
A.	P.12	Grass for bedding only. 2 cattle in the kraal all the time ...	335	521
C.	P.13	Day and night grazing. 1 bullock ...	262	429
B.	P.14	Grass for bedding only. 2 cattle on permanent pasture by day ...	344	484
D.	P.15	Night grazing only. 2 Bullocks ...	287	453

The results are consistent. Farmyard manure appears to give better yields than dropped manure on cotton. It cannot, however, be assumed at this stage that this is true for all crops. Day grazing gave the worst results in both cases.

The live weight gains of the cattle on the corresponding plots P 1-5 which have been resting in their first year are as follows:—

Treatment No.	Plot No.	Cumulative liveweight gain April-March	
		1947/48	1944/45
		<i>lbs.</i>	<i>lbs.</i>
A.	P.1	179	35
B.	P.2	172	148
C.	P.3	239	111
D.	P.4	174	154
E.	P.5	130	175

These figures are not consistent.

The paddocks P.1-5 were sown with *Chloris gayana* at the rate of 20 lbs. to the acre in January and the cattle were put in in June, 1947.

(ii) GRAZING TRIAL. *CHLORIS GAYANA* versus NATURAL REGENERATION

This is a replicated experiment consisting of $16 \times \frac{1}{2}$ acre plots (4×4 latin square). The object is to test the grazing of planted *Chloris gayana* plots against plots regenerating naturally. There are two grazing rates for each treatment, i.e., Heavy=1 beast to the acre, and light= $\frac{1}{2}$ beast to the acre. The results from this experiment will be obtained from the differences in the liveweight gains of the animals concerned.

At the onset of the first rain in February, 1948, the *Chloris* plots were weeded and grass was transplanted into them in an attempt to get as even and good a stand as possible. The stand is on the whole good and the grass should get away when further rain falls. No animals were put into the plots during the period under review.

(iii) NO-LIGHT-HEAVY GRAZING TRIALS

These trials are situated on the main farm on strips B6E, B6C, C1E, C1C and C3E.

The position during the year was as follows:—

P.16-21 on B6C and E laid down in 1940. In its third year of cropping: Groundnuts and then allowed to rest.

P.36-41 on C1C and E laid down in 1941: in its second year of cropping: Cow Peas followed by groundnuts.

P.48-53 on C1E laid down in 1942 in its second year of cropping and cropped as P.36-41.

P.57-62 on C3E and laid down in 1943 which is in its first year of cropping: early cotton.

Summary of Results 1947:—

Treat- ment	Paddock No.	<i>Chloris gayana</i> Yield per acre in lbs. Groundnuts unshelled	Paddock No.	Natural Regeneration Yield per acre in lbs. Groundnuts unshelled
No ...	P.16	1,908	P.21	1,840
Light ...	P.18	1,552	P.19	1,548
Heavy ...	P.17	1,512	P.20	2,030

Treatment		Paddock No.	<i>Chloris gayana</i>		Paddock No.	Natural Regeneration	
			(I)	(II)		(I)	(II)
No ...	...	P.39	2,168	584	P.38	1,148	630
Light ...	...	P.40	1,630	404	P.36	1,896	410
Heavy ...	...	P.41	2,054	262	P.37	786	698
No ...	...	P.48	1,562	350	P.52	830	212
Light ...	...	P.49	1,696	358	P.53	966	264
Heavy ...	...	P.50	1,596	396	P.51	896	246
			Yield per acre Seed cotton in lbs.				
No ...	...	P.59	494	...	P.60	388	...
Light ...	...	P.58	346	...	P.61	460	...
Heavy ...	...	P.57	462	...	P.62	468	...

(I) Yield per acre *Eleusine* in lbs. unthreshed heads.

(II) lbs. per acre Cow Peas.

There have been no significant results from this experiment since its inception in 1940.

The *Chloris gayana* was planted at the rate of 20 lbs. per acre on P.16-18 on 14th August, 1947. There was no grazing carried out on this experiment during the period under review.

12. Fertility Experiment

The yields and results are reported at Appendix A of this report. The position during the period under review was as follows:—

Cycle I ... 2nd year in 3rd circuit. *Eleusine* followed by Late cotton in 1948.

Cycle II ... 1st year in 3rd Circuit. Early cotton.

Cycle III ... 5th year in 2nd Circuit. Resting treatments. It was noticed this year when opening up the plots for early cotton how very much harder the ground was on the grazed plots. (The labour actually picked them out and left them until the last when digging over).

Cycle IV ... Fourth year in 2nd Circuit. Sorghum followed by late cotton and resting treatments.

Cycle V ... 3rd year in 2nd Circuit. Groundnuts and sweet potatoes and resting treatments.

An important change was made this year with regard to the planted grass treatments by the replacement of *Cynodon* spp. with *Chloris gayana*. In consultation with Dr. Yates of Rothamsted this is being done with each successive cycle of the experiment and its statistical validity will not be affected.

13. Livestock

(a) CATTLE

(i) Numbers in Herds

Herd bulls	...	...	3
Oxen	...	...	113
Young male stock	...	...	7
Cows	...	...	74
Heifers	...	...	43
Calves	...	...	48
TOTAL			288

(ii) Milk Yields and Lactations

The following is a summary of the lactations of the best cows:—

No.	Name	Lac- tation	Yield in gallons	No. of days in milk
64	Akwazo II	4th	259	300
83	Yechu	1st	249	304*
58	Azeto	5th	209	247
48	Achimo	2nd	212	287
14	Butara	5th	207	213
68	Ilyaboi	6th	204	302
12	Naitono	8th	185	249
39	Zenero II	4th	186	232

* Milked out

In 1946 only 2 cows were over 200 gallons and one over 180 gallons.

Apecho II the best milked out cow has given 136 gallons in 270 days.

The last 3 lactations of Akwazo II have steadily improved, the figures being 198 gallons, 235 gallons and 259 gallons. It is considered that these improvements are almost entirely due to better management, particularly feeding. It is hardly possible that improved breeding has had time to have a marked effect. Sixty cows have been in milk during the year. The results from the milked out cows has been on the whole satisfactory. The figures (taken on spot checks) of the average amount of milk per cow in the milked out and calf at foot herds is roughly the same, i.e. between 0.6 and 0.7 of a gallon per day. The milked out herd is handicapped at present by the number of cows in this herd which are only in their first and second lactations.

(iii) *Live weight Gains*

The following are the accumulative live weight gains and the average gain per day from April, 1947, to March, 1948.

HERD	ACCUMULATIVE GAIN LBS.		AVERAGE GAIN/DAY
	1946-47	1947-48	1947-48
Heifers Experiment Farm ...	165	162	lbs. 0.47
Unallocated Steers ...	94	71	0.35
Cows in kraal ...	92	107	0.34
Free range Cows ...	...	77	0.44
Free range calves ...	...	308	0.83
Unweaned calves ...	128	125	0.34
Bucket fed calves ...	...	216	0.56
Steers Old Farm ...	208	207	0.57
Heifers P.54-56 ...	125	139	0.41
Steers Experiment Farm ...	134	140	0.44

The long dry season and the advent of the Army Worm in February, 1948, caused a drop in the live weight of most of the herds.

(iv) *Milk and Dairy Produce Disposal, April-March 1947-48*

The amounts of the various dairy products sold and issued throughout the year are given in a table at Appendix C.

The amount of revenue received during the year from Dairy products is Shs. 3,280/50. On the face of it this is a comparatively small sum but due consideration must be made for free issues which would have totalled another Shs. 2,010 approximately. The sales of meat and hides realised another Shs. 4,329/62. The sum received purely from Dairy products, pays the salaries of 1 headman, 6 milkers, 2 herdsman and one porter (totalling Shs. 3,108 per annum).

These are the men intimately connected with the dairy herds.

(iva) *Valuation of Stock*

An estimate of the value of the stock is given below:—

Value of stock at 1st April, 1947				Value of stock at 31st March, 1948			
			Shs.				Shs.
1.	Bulls (3 @ Shs. 200) ...	...	600		Bulls (6 @ Shs. 200)...	...	1,200
2.	Bullocks (109 @ Shs. 150) ...	...	16,350		Bullocks (110 @ Shs. 150) ...	...	16,500
3.	Young steers (13 @ Shs. 80) ...	...	1,040		Young steers (7 @ Shs. 80) ...	...	560
4.	Milking cows (64 @ Shs. 200) ...	...	12,800		Milking cows (61 @ Shs. 200) ...	...	12,200
5.	Heifers (40 @ Shs. 100) ...	...	4,000		Heifers (56 @ Shs. 100) ...	...	5,600
6.	Calves (56 @ Shs. 40) ...	...	2,280		Calves (49 @ Shs. 40) ...	...	1,960
	Appreciation...	...	350				
TOTAL			37,420		TOTAL	...	37,420

(v) *Births and Deaths*

The number of calves born during the period under review was 58, of which 32 were males and 26 females. Seven bull calves and five heifer calves died. Most of these deaths can be put down to errors in hand rearing.

28 old oxen and barren cows were slaughtered for meat. One young bull was sold for Shs. 180 and one bull was sent to Ngetta and another to Entebbe (Veterinary Department).

(b) *PIGS*

A breeding herd of 3 sows has been maintained. The local people are not yet "pig minded" and do not keep pigs, but the small breeding herd is valuable for experimental purposes as well as for teaching propaganda.

Considerable trouble has been experienced from sows farrowing with no milk. Attempts were made to hand feed the young pigs but this can never pay although a few survived. In order to try to alleviate this trouble fresh blood has been ordered.

The number of pigs weaned during the period under review was 15 out of thirty-seven born.

14. Mechanical Cultivation (Costings)

It is still difficult to obtain fair cost of ploughing operations when the inexperience of the crews and the sometimes difficult nature of the land is taken into consideration. Disregarding the cost of depreciation which would naturally be high for the uneconomical way the outfits are used (and this must be the case on an experimental station), the following records have been kept:—

(a) BLOCK A. EXPERIMENT FARM. 10 ACRES FIRST PLOUGHING AFTER THREE YEARS RESTING

		Shs. cts.	
For 10 acres	Cost of Kerosene	...	101 20
	Cost of Petrol	...	2 80
	Cost of Oil	...	2 00
	Drivers' wages	...	10 00
	Assistants' wages	...	3 00
TOTAL		...	119 00

Cost per acre=Shs. 11/90

(b) FIVE-ACRE PLOT FOR URENA LOBATA INCREASE

First ploughing after 6 years. Conditions of ploughing:—

There were small stumps which were removed and there were also long uncut roots from bordering trees. There was a very thick mat of *Imperator* spp. Three acres of the worst part was ploughed a second time.

				<i>Shs. cts.</i>	
For 8 acres	...	Cost of Kerosene	...	108	10
		Cost of Petrol		2	80
		Cost of Oil		2	00
		Drivers' wages		10	00
		Assistants' wages		3	00
		TOTAL	...	125	90

Cost per acre=Shs. 15/74

The extra cost for the latter example is accounted for by the more difficult conditions. Both plots took almost exactly the same time to do, i.e. 25 working hours, and the costs both include expenses in travelling to and from the work.

It is interesting to note that since these trials were carried out the cost for ploughing a strip on the main Farm only amounted to Shs. 7 per acre. This plot was ploughed with the disc plough in second gear, and the ground was soft.

15. Education Section

(Compiled by J. F. Low, Esq., S.E.A.A.).

A total of 986 persons attended the various courses from April, 1947, to March, 1948, made up from the following:—

APPRENTICES' COURSE. PERIOD—ONE YEAR

There were twenty Apprentice students who joined the course on 1st April, 1947, from the following tribes: four from Karamoja, two Acholi, two Lango, two Wanyoro, one Lugwala, one Arur, four Muteso, one Mugishu, one Mugwere, one Musoga and one Musamya. They all completed the course and were passed out and recommended for employment on 31st March, 1948. The Wakaramojong had to have extra lessons in arithmetic throughout the year and were taught as much practical work as possible but only become useful instructors after experience in the field.

MAKERERE STUDENTS. PRACTICAL FARMING. PERIOD—ONE YEAR

There were none for the year 1947.

Eleven students arrived for one year's training in February, 1948, and are continuing their course. This is the first year of the change-over from Fourth year students to Third year students and as a result they are a mixture of both third and fourth year students.

PRISON WARDERS' COURSE. PERIOD—FOUR WEEKS

A total of 48 Warders attended this course from various prisons. They were all keen. It is suggested that each prison should have a bellows, anvil and hammers for the care and sharpening of tools; the warders are taught this work during the course and a considerable saving in man days could be effected, if they could do these jobs on the Prison Farms.

CHIEFS' AND CULTIVATORS' COURSES. PERIOD—ONE WEEK

A total of 225 people of whom 14 were women attended. They were interested and a number asked if they could remain for an additional week; whether this was due to the good feeding they get here, or genuine interest is hard to say. These courses are undoubtedly useful and more follow-up work should be carried out when the staff position permits.

TEACHERS' COURSES. PERIOD—TWO WEEKS

A total of 124 attended the course of whom 42 were women. There were not so many groups as usual due to lack of funds. This has now been remedied for the 1948 courses.

INSTRUCTORS' REFRESHER COURSES. PERIOD—TWO WEEKS

78 Assistant Instructors attended this course. The course brought to light the poor material of some of these Instructors.

CATTLE KEEPERS' COURSE. PERIOD—ONE WEEK

A total of 133 men attended these courses. Most groups showed great interest in the work going on at Serere and there was a demand for young bulls—unfortunately the supply is at present very limited—which indicates that the younger generation in particular are keen to improve the quality of their livestock.

EX-ASKARIS' TRAINING COURSE. PERIOD—SIX WEEKS

The remaining applicants to the number of 347 came for training. Of these, 273 completed the course, 59 left when they were told there was no job at the end of it and 15 were dismissed as being unsuitable. A number of these askaries did well when returned to their homes, but percentage of successful ones is unfortunately small. As with other persons attending these courses, follow-up work is essential otherwise they soon lose heart.

A. E. B. WILLIAMS,
Agricultural Officer in Charge, Serere.

Fertility Experiment 1947

APPENDIX A.

TABLE I
CROPPING

Cycle			Circuit	Year	Cropping	Plots
I	...	...	Third	Second	<i>Eleusine</i> —cotton	90
II	...	...	Third	First	Early Cotton	90
III	...	...	Second	Fifth	Resting	90
IV	...	...	Second	Fourth	Sorghum—Cotton	30
V	...	...	Second	Third	Groundnuts—Sweet Potatoes	60

TABLE II
ANALYSIS: EFFECT OF MANURES

Yields in lbs./acre unthreshed heads, Groundnuts in shell and seed cotton

Farmyard Manure	CYCLE II	CYCLE I		CYCLE V		CYCLE IV	
	Early Cotton	<i>Eleusine</i>	Cotton	Ground Nuts	Sweet Potatoes	Sorghum	Cotton
No Manure ...	625	1,071	269	1,473	1,707	1,123	293
2½ tons/acre ...	650	1,216	394	1,654	1,555	1,044	253
5 tons/acre ...	682	1,108	443	1,805	1,915	1,204	317
Significance—							
Linear ...	20 : 1	None	1000 : 1	1000 : 1	None	None	None
Quadratic ...	None	20 : 1	20 : 1	None	None	None	None

These results confirm previous years' results but the yield differences between the manured plots and the unmanured plots is tending to widen.

TABLE III
ANALYSIS EFFECT OF COVER CROPS
Yields in lbs./acre

Cover Crop	CYCLE II	CYCLE I		CYCLE V		CYCLE IV	
	Early Cotton	<i>Eleusine</i>	Cotton	Ground Nuts	Sweet Potatoes	Sorghum	Cotton
A. Natural Regeneration ...	665	1,072	376	1,633	2,026	1,153	300
B. Planted <i>Cynodon</i> ...	647	1,062	331	1,578	1,253	1,105	310
C. <i>Mucuna</i> Slashed ...	660	1,220	348	1,676	2,010	1,086	315
D. Planted <i>Cynodon</i> Grazed ...	701	1,157	397	1,571	1,286	1,184	231
E. <i>Mucuna</i> dug in ...	590	1,146	392	1,161	2,052	1,091	231
Significance—							
1. Grass and Green <i>Mucuna</i> ...	20 : 1	None	None	20 : 1	None	None	None
2. G.M. dug in and G.M. Slashed ...	20 : 1	None	None	None	None	None	None
3. Planted Grass and N. Regeneration ...	None	None	None	None	None	None	None
4. Planted Grass Grazed and planted Grass ...	None	None	100 : 1	None	None	None	None

The results are similar to previous years. The differences are small but the tendency is for Grazing to beat Green manures. The grazing of *Cynodon* is better than no grazing.

TABLE IV
ANALYSIS EFFECT OF CROPPING RATIO
Yields in lbs./Acre

Cropping Ratio	CYCLE II	CYCLE I	
	Early Cotton	<i>Eleusine</i>	Cotton
4 : 1	662	894	320
3 : 2	644	1,197	384
2 : 3	651	1,304	403
Significance—			
Linear ...	None	1000 : 1	1000 : 1
Quadratic ...	None	None	None

COMBINED ANALYSIS

TABLE V
EFFECT OF MANURES: SWEET POTATOES—EIGHTH YEAR
Yields in lbs. per Acre Fresh Roots

Blocks	I & II	III & IV	V & VI	VII & VIII	IX & X	MEAN	MEAN
	1943	1944	1945	1946	1947	1938-42	1943-47
M 1 ...	1,167	4,237	2,358	4,400	1,707	2,774	3,618
M 2 ...	1,677	4,734	3,426	5,086	1,555	3,296	4,163
M 3 ...	1,280	6,199	3,498	5,735	1,915	3,725	3,969
Significance:							
Linear ...	None	1000 : 1	1000 : 1	1000 : 1	None	1000 : 1	None
Quadratic...	50 : 1	None	None	None	None	None	None

The sweet potatoes are planted one year after the manures are applied.

TABLE VI
EFFECT OF CROPPING RATIO: SWEET POTATOES—EIGHTH YEAR

Blocks	I & II	III & IV	V & VI	VII & VIII	IX & X	MEANS
	1943	1944	1945	1946	1947	5 years
<i>Crop Rest—</i>						
4 : 1	1,318	5,505	3,111	5,287	1,890	3,422
3 : 2	1,431	4,608	3,077	4,861	1,561	3,108
2 : 3	...	...	...	...	...	...
Significance	None	20 : 1	None	None	None	None

TABLE VII

EFFECT OF COVER CROP TREATMENTS—SWEET POTATOES: EIGHTH YEAR

Blocks	I & II	III & IV	V & VI	VII & VIII	IX & X	MEANS
	1943	1944	1945	1946	1947	5 years
<i>Treatments—</i>						
A. Natural Regeneration	1,792	4,783	3,154	6,064	2,026	3,564
B. Planted <i>Cynodon</i> ...	1,341	4,628	3,056	5,098	1,253	3,075
C. <i>Mucuna</i> Slashed ...	1,294	4,838	3,171	4,964	2,010	3,255
D. Planted <i>Cynodon</i>						
Grazed ...	1,157	5,165	3,342	4,697	1,286	3,169
E. <i>Mucuna</i> dug in ...	1,289	5,871	2,747	4,546	2,052	3,301
<i>Significance:—</i>						
Grass and Green manure	None	None	None	None	None	None
Green manure dug in						
and Green manure						
Slashed ...	None	None	None	None	None	None
Planted Grass and Natural						
Regeneration ...	50 : 1	None	None	None	20 : 1	20 : 1
Planted Grass Grazed and						
Planted Grass not						
Grazed ...	None	None	None	None	None	None

There are no consistent differences in the above analysis.

TABLE VIII
COTTON YIELDS 1947/48 (S.5302)

Strip	Area (Acres)	Sowing Date	Date of first Harvesting	Safi	Fifi	Total Yield in lbs.	Yield per acre	Yield safi per acre	Yield fifi per acre	Fifi %
A3 (E)	1.86	22-5-47	16-10-47	1,007	118	1,125	605	541	63	10
A3 (C)	2.79	23-5-47	17-10-47	2,269	368	2,637	945	813	132	14
A3 (W)	0.77	23-5-47	16-10-47	436	61	497	645	566	79	12
B3 (E)	5.64	9-6-47	30-10-47	1,933	246	2,179	386	343	44	11
B3 (C)	2.05	5-6-47	29-10-47	1,739	262	2,001	976	848	128	13
B3 (W)	0.95	5-6-47	29-10-47	527	70	597	628	555	74	12
C3 (E)	7.57	22-7-47	22-11-47	2,794	39	2,833	374	369	5	1
C3 (C)	1.61	24-7-47	28-11-47	757	18	775	481	470	11	2
C3 (W)	1.64	23-7-47	25-11-47	778	28	806	491	474	17	3
D3 (W)	1.50	23-7-47	24-11-47	422	27	449	299	281	18	6
D6 (E)	6.80	24-7-47	26-11-47	1,480	93	1,573	231	218	14	6
TOTALS Main Farm	33.18			14,142	1,330	15,472	466	MEAN PER ACRE 426	40	9
Block IX	8.02	11-6-47	7-11-47	3,778	332	4,110	512	471	41	8
Block I	2.61	29-5-47	16-10-47	2,995	219	3,124	1,197	1,113	84	7
B3 T.F.	1.93	1-8-47	28-11-47	577	30	407	211	195	16	7
B4 T.F.	1.96	31-7-47	28-11-47	463	33	496	253	236	17	7
B6 T.F.	2.10	22-5-47	11-10-47	1,462	178	1,640	781	696	85	11
GRAND TOTALS	49.80			23,127	2,122	25,249	GRAND MEAN 507	MEAN YIELDS 464	43	8

Crop Yields 1947/48.

APPENDIX B.

TABLE I
FINGER MILLET (*Eleusine*)

Strip or Plot	Variety	Planted	Harvested	Acreage	Yield in lbs.	Yield per acre	Mean
AIE	Mixture of 5 ...	14-3-47	28-6-47	0.85	1,606	1,889	
AIC	Emoru ...	18-3-47	25-6-47	3.65	6,685	1,832	
AIW	Mixture of 5 ...	14-3-47	4-7-47	0.43	339	788	
BIE	Engenyi ...	11-2-47	12-6-47	5.03	5,662	1,126	
BIC	Engomu ...	17-3-47	3-7-47	2.70	4,239	1,570	
BIW	Ekwakoit ...	12-2-47	21-6-47	1.10	1,408	1,280	
B ₄ T.F.	Mixture of 5 ...	15-2-47	16-6-47	1.93	4,322	2,205	
CIE	Mixture of 5 ...	7-3-47	30-6-47	9.58	12,152	1,268	
CIC	Mixture of 5 ...	8-3-47	27-6-47	1.97	2,893	1,469	
CIW	Emiroit ...	14-3-47	4-7-47	1.39	2,500	1,799	
D ₅ E	Mixture of 5 ...	17-3-47	4-7-47	1.03	1,618	1,571	1,464
P89-100	Mixture of 5 ...	20-2-47	25-6-47	3.00	4,895	1,632	1,632
Block 9	Mixture of 5 ...	28-3-47	11-7-47	0.90	1,620	1,800	1,800
Cycle I	Engenyi ...			3.00	3,395	1,132	1,132
TOTALS AND MEANS				36.56	53,334	1,459	

TABLE II
SORGHUM

(a) 10 acres of T.7 were grown for silage.

(b) 9.65 acres of T.7 were grown for seed, as shown below:—

Strip	Variety	Acreage	Yield per acre
A6E & DIW	T.7 ...	5 acres	lbs. 615 unthreshed
D ₅ E	T.7 ...	4.65 acres	1,318 unthreshed
B ₃ Training Farm	T.7 Sorghum and <i>Eleusine</i> (mixed) ...		999 unthreshed
			1,218 unthreshed

TABLE III
GROUNDNUTS

The following table summarises the yields:—

Strip or Plot	Variety	Planted	Harvested	Acreage	Yield in lbs.	Yield per acre	Mean
B6E	B.239 ...	22-3-47	9-7-47	5.90	9,514	1,613	
B6C	B.239 ...	22-3-47	7-7-47	2.04	3,553	1,742	
B6W	B.239 ...	24-3-47	17-7-47	1.20	2,388	1,990	1,691
Block 3	B.239 ...	27-3-47	18-7-47	0.65	808	1,381	1,381
B.5 T.F.	B.227 ...	24-3-47	8-7-47	2.04	2,049	1,004	1,004
Cycle V	B.239 ...	24-3-47	15-7-47	2.00	3,287	1,643	1,643
Block 4	B.239 ...	25-3-47	8-7-47	1.25	2,061	1,649	1,649
P. 79-88	B.239 ...	19-3-47	5-7-47	2.50	2,752	1,101	1,101
TOTALS AND MEANS				17.58	26,502	1,508	

TABLE IV

SESAME

Strip	Variety	Acreage	Yield per acre
C6C	Kumam Kamod	.63 .63	216 lbs. 170 lbs.

TABLE V

SWEET POTATOES

Strip	Variety	Acreage	Date planted	Date harvested	Yield/ acre
					<i>lbs.</i>
A6 (E)	... Mixture	2.98 AC	16-8-47	23- 1-48	353
A6 (C)	... Mixture	2.79 AC	13-8-47	24- 1-48	633
A6 (W)	... Mixture	1.05 AC	13-6-47	25-11-47	5,824
D1 (W)	... Mixture	1.76 AC	9-8-47	19- 1-48	215
D4 (E)	... Mixture	5.51 AC	7-5-47	22-9- 21-12-47	6,105
Block F	... Mixture	2.62 AC	24-4-47	9-8- 30- 9-47	5,074

Please note the poor yield on A6C, and A6E and D1W, were caused by the dry spell.

TABLE VI

BEANS

Strip	Variety	Yield/ acre
		<i>lbs.</i>
Block Z	Namunye	514
	Mutike No. 2	362
	Banja	757
	Mixed Mutike Red	357
	Kainja	400
C.6.E	Tepary	356

TABLE VII

MAIZE

Strip—Block Z.

Variety—Sahara Yellow.

Yield/acre—2,608 lbs. on the cob.

TABLE I
MILK AND DAIRY PRODUCE DISPOSAL APRIL-MARCH 1947/48

Total amount of milk produced	Free issues and losses	To bucket fed calves	Sales	Separated	Cream made	Ghee made	Butter made	Cream sold	Ghee sold	Butter sold
<i>gallons</i> 7,130	<i>gallons</i> 495	<i>gallons</i> 1,235	<i>gallons</i> 1,963*	<i>gallons</i> 2,946	<i>lbs</i> 2,719	<i>lbs.</i> 661	<i>lbs.</i> 1,139	<i>pints</i> 81†	<i>lbs.</i> 506‡	<i>lbs.</i> 164§

* Revenue received Shs. 1,963

† Revenue received Shs. 81.

‡ Revenue received Shs. 809/50.

§ Revenue received Shs. 426/75

REPORT ON BUGUSEGE COFFEE EXPERIMENT STATION

1. Arabica Coffee

1932 PRUNING AND SPACING EXPERIMENT

Yields in cwts. of fresh cherry per acre were:—

	SPACINGS				Means
	8'×8'	7'×7'	6'×6'	4'×4'	
1947—					
Unlimited Terminal growth ...	57·84	39·52	67·27	56·95	55·39
Modified Multiple Stem ...	47·21	49·63	56·82	47·52	50·29
Total to date—					
Unlimited Terminal growth ...	499·38	479·20	549·99	687·37	553·98
Modified Multiple Stem ...	462·72	540·94	523·32	517·94	511·23

While both treatments gave fairly similar yields there appears to be tendency towards biennial fluctuation in the Unlimited Terminal Growth treatments. All treatments suffered severely from “buni” (dried cherry) formation.

Samples taken from each treatment were sent to three commercial firms for report and valuation. Two reports have so far been received and the mean values expressed in Shillings per cwt. are as follows:—

Spacings		Unlimited Terminal Growth	Modified Multiple Stem
		Shs.	Shs.
4'×4'	...	143 00	145 00
6'×6'	...	143 50	147 00
7'×7'	...	143 00	146 00
8'×8'	...	144 00	143 50
MEAN VALUE	...	143 37	145 37

Although the differences are small, there is a closer correlation between treatment and value than in previous years and a slight bias in favour of the Modified Multiple Stem treatments—possibly due to a slightly larger bean. Samples were also taken from each treatment for examination of insect damage by the Entomologist.

(b) 1936 SPACING, STUMPING AND UPROOTING EXPERIMENT

Yields in Cwts. of Fresh Cherry per Acre:

	SPACINGS		
	3'×3'	4'×3' 9"	5'×5'
1947—			
Uproot alternate Rows ...	42·32	47·99	24·01
Stump alternate Rows ...	39·17	22·30	27·12
Total to date—			
Uproot alternate Rows ...	269·71	245·38	243·85
Stump alternate Rows ...	240·77	249·97	248·31

It is now abundantly clear that in the $5' \times 5'$ uproot alternate row treatment, this spacing is too wide as the remaining trees are spaced at $10' \times 10'$ intervals and yields are steadily declining. It will be of considerable interest to see if, during the next year or so, yields at the closer spacings can be maintained by means of stumping as a method of pruning.

(c) 1941 SHADE AND MULCH OBSERVATION TRIAL

Yields in Cwts. of Fresh Cherry per Acre:

	1949		Total to date
Shade and Mulch ...	<i>Cordia</i> ...	14.90	125.70
	<i>Croton</i> ...	4.86	57.71
	<i>Ficus</i> ...	3.70	67.39
	Totals ...	23.46	250.70
	Means ...	7.82	83.57
Shade and no Mulch ...	<i>Cordia</i> ...	14.19	140.29
	<i>Croton</i> ...	1.92	77.87
	<i>Ficus</i> ...	8.31	103.54
	Totals ...	24.42	321.70
	Means ...	8.14	107.23
Mulch and no Shade ...	A. ...	24.80	154.73
	B. ...	25.70	143.08
	C. ...	29.54	114.97
	Totals ...	80.04	412.78
	Means ...	26.68	137.59

Cordia still remains the best shade as regards the yield and the appearance of the coffee under it. The experiment is however sited on very variable soil, fertility being lowest in the portion under *Croton* shade. It is probable that this experiment will be abandoned.

(d) REPLACEMENT TRIAL (1947) BUGUSEGE

This observation experiment was laid down as a result of the high death rate in 1945 and 1946 of seedlings planted in native plots under the Coffee Replacement Scheme. The object is to test whether seedlings or two-year old stumps are adversely affected by the proximity of old established coffee or by the residual effect of uprooted coffee.

Treatments.—Single and multiple (3 and 8) lines of old coffee uprooted and replaced by:—

(a) Seedlings planted between the *lines* of uprooted coffee.

(b) Seedlings planted between the *rows* of uprooted coffee.

In the control plot the old coffee was stumped. The plot with eight lines uprooted was subdivided to test Castor (*Ricinus Communis*) as a shade tree. The old coffee planted in 1932 was uprooted in June, 1947, and the seedlings and stumps were planted on 1st August, 1947.

The number of deaths was counted on 13th February, 1948. Losses were as under:—

Seedlings between lines	...	...	12·5%
Seedlings between rows	...	...	12·0%
Stumps between rows	...	...	14·2%

(e) REPLACEMENT OBSERVATION PLOT (1947) BUDUDA

In this small plot uprooting took place in July, 1947, and the two-year old stumps and seedlings were planted during the last week of July. When the number of deaths was counted in February, 1948, it was found that the only losses were in the line of seedlings adjacent to the old coffee. In this line 30% of seedlings died, suggesting that the proximity of the old coffee trees had affected the “take”.

(f) BASKET FERMENTATION TRIAL (1947)

Samples of parchment coffee were sent to three commercial firms to test previous findings regarding the best time of fermentation of small parcels of coffee. From the reports received the following conclusions were drawn:—

(a) Coffee fermented once, for a period of 15 hours approximately, is superior at the lower altitudes to coffee fermented twice, e.g. washed after the first fermentation and then fermented again for about 15 hours.

(b) The effect of mudding the baskets, or covering the baskets with banana leaves, to maintain the heat of fermentation, is unimportant.

These reports confirm previous findings on this subject.

W. T. O. MAIDMENT,
Provincial Agricultural Officer, Eastern Province.

PASTURE WORK AT NGETTA FARM

(a) GRAZING TRIAL (1941)—NO: LIGHT: HEAVY GRAZING, BLOCK V

Having completed its first cycle of three years grazing and three years cropping, this trial was again put down to grass to commence its second cycle. The six $\frac{1}{3}$ -acre plots repeat the 1941 treatments: Natural Regeneration and *Chloris gayana* with heavy, light and no grazing. Owing to lack of labour the plots were not fenced until September and grazing commenced in October.

(b) GRAZING TRIAL (1942)—NO: LIGHT: HEAVY GRAZING, BLOCK VI

This trial was under groundnuts as an index crop, being in the third year of cropping in its first cycle. Yields of groundnuts (unshelled nuts) per acre were as follows:—

	<i>Chloris gayana</i>	Natural Regeneration	Mean
No grazing ...	1,433	695	1,064
Light grazing ...	1,214	1,084	1,149
Heavy grazing ...	1,483	1,160	1,322
MEAN ...	1,377	980	1,178

The differences are not significant, but the results will be used for combined analysis with other years and with Serere results. As in the previous year *Chloris gayana* appears to show better regenerating powers than the natural vegetation, and the results from the different grazing treatments follow the same order as last year.

Groundnuts were followed by Mtama which failed to develop due to drought and was used for silage.

(c) GRASS VARIETY, SEED RATE AND SOWING DATE TRIAL (1943), BLOCK I

This trial was under finger millet in the second year of cropping. Yields in unthreshed heads per acre were as follows:—

	Early Sown	Late Sown	Mean
<i>Chloris</i> 16 lbs./acre...	1,771	1,701	1,736
<i>Chloris</i> 24 lbs./acre ...	1,922	1,454	1,688
Mean <i>Chloris</i> ...	1,847	1,578	1,712
<i>Brachiaria</i> 2' × 1' ...	2,327	1,639	1,983
<i>Brachiaria</i> 1' × 1' ...	1,685	1,573	1,629
Mean <i>Brachiaria</i> ...	2,006	1,606	1,806
General Mean ...	1,926	1,592	1,759

The replication is insufficient to produce significance from one year's results but the indication is that early sowing of grass is advantageous.

The simsim which followed the finger millet was a complete failure due to drought.

(d) GRAZING TRIAL (1944)—BLOCK II

This trial, which consists of Natural regeneration, *Chloris gayana* and *Brachiaria decumbens*, grazed and ungrazed was ploughed up and

planted with cotton as an index crop for the commencement of the three years' cropping cycle.

Yields of seed cotton per acre were as follows:—

	Natural Regeneration	<i>Chloris</i>	<i>Brachiaria</i>	Mean
Grazed	324	320	271	305
Ungrazed	280	349	260	296
Mean	302	335	266	...

These results by themselves are not significant but the tendency for grazed land to give better crops than ungrazed and for *Chloris* to beat natural regeneration confirms other years' results.

(e) GRAZING TRIAL (1945) BLOCK III AND (f) GRAZING TRIAL (1946) BLOCK IV

These are the second and third parts of the above and were in their third and second years of rest respectively. During the protracted dry season the grazed plots became very bare but did their share in maintaining the fixed herd.

(g) GRASS VARIETY OBSERVATION PLOTS (1946) BLOCK IV

These plots of one acre each contain *Chloris gayana* (seeded), *Hyparrhenia rufa* (seeded) and *Brachiaria decumbens* (planted). They were laid down in April/June, 1946, and grazing did not commence until April, 1947. During the year now being reported upon these three acres supplied 1,425 ox grazing days or, in other words, carried stock at the rate of 1.3 mature bullocks per acre. It should be noted, however, that the grasses had almost a full year to establish themselves before grazing commenced.

Hyparrhenia rufa continued to be the grass most favoured by the cattle and, since it comes well from seed, this species merits closer attention. During the long drought all the plots were grazed very severely and there was a tendency for the *Hyparrhenia* to be eaten down into small, slightly raised, close cropped tufts with bare areas between, which might be liable to permit soil wash during the first rains after the dry season.

Stock Carrying Capacity at Ngetta

During the year the average area of land resting on the Experiment Farm at Ngetta was 16 acres and this provided 5,291 ox grazing days, which works out at 0.9 ox-days per acre. The cattle maintained themselves in good condition during the rains and there was abundance of grass until well into the dry season, which lasted for five months. Towards the end of this period the paddocks became very bare and it was difficult to see where the cattle obtained their sustenance. They were closely observed with a view to removing them immediately it might become necessary to do so. There was a slight falling off in condition in March, but the herd was actually maintained on the Experiment Farm grass plots until 31st March without supplementary feeding. At the end of March, 1948, however, it was felt that as soon as the rains came it would be

advisable to give the paddocks a period of rest to allow the grasses a reasonable chance to recuperate. The cattle were watered in the paddocks to obviate the possibility of grazing while on their way to and from the trough at the stock farm where they had hitherto been taken.

R. P. DAVIDSON,
Provincial Agricultural Officer, Northern Province.

GRASS FALLOW IN UGANDA

EVIDENCE FROM SERERE AND NGETTA FARMS

A great deal of evidence has been accumulated which indicates that fertility can be maintained on many of our soils for a long time by use of an adequate period of fallow under grass. Though it may theoretically be possible for the rate of nitrogen accumulation in the soil by synthesis or deposition in rain water to equal or exceed the rate of removal in crops, minerals such as phosphate and potash cannot be replaced by means of fallow period. The fallow period may make these minerals available in increased quantities, but the total quantity in the soil can be maintained at a constant level only by returning an amount equivalent to the amount removed. Data as to the mineral reserves in our soils are not yet available. The experiments described in this paper were designed to test out what form of rotation will give the best crop yields over a limited period of years.

Evidence for effectiveness of a grass fallow rests upon the experience of African farmers who have used it for many generations. Some confirmatory evidence has been obtained from departmental farms where this method of maintaining fertility has been used for some years.

AT NGETTA

Ngetta Farm near Lira was opened by the Agricultural Department in 1925. During the period 1926-1933 it was farmed on an irregular rotation without resting under grass. By 1933 it was found that the fertility of the farm had deteriorated and it has been run on a six-course rotation with three years under crops and three years under grass since 1934. There are six seven-acre blocks on the farm, one of which is opened to cropping each year and one goes back to a grass ley.

The sequence of crops during the three years cropping has been:—

1st year ... Cotton.

2nd year ... *Eleusine* and pigeon peas followed by simsim sown under the standing pigeon peas.

3rd year ... Groundnuts. In recent years groundnuts have been followed by sorghum.

No manure has been applied to the farm since 1934.

During the resting period seeding trials with various grass species have been carried out, but the dominant grass species has usually been a local form of Star Grass, *Cynodon plectostachyum*, which comes in naturally when leys are grazed in this area. The ley period has been grazed by a fixed herd of bullocks which remain on the farm throughout the year. In general these bullocks have not received supplementary food and have obtained all their food on the farm. The stocking rate has varied slightly from time to time, but has usually been slightly more than one beast to the acre of grazing land. These bullocks have kept in good condition throughout the year.

In Table 1 yields of cotton, *eleusine* and groundnuts since this rotation was adopted are given. Mr. H. G. Milne, Agricultural Officer, has kindly sorted out these figures from the farm records. In some cases yields refer to part of a block only, but may be considered representative. Yields of simsim and pigeon peas are not given as full records are not available.

TABLE 1
Ngetta Farm Mean Crop Yields: Pounds per Acre

Block	FIRST CIRCUIT			SECOND CIRCUIT			THIRD CIRCUIT		
	Cotton	<i>Eleu-sine</i>	Grnd. Nuts	Cotton	<i>Eleu-sine</i>	Grnd. Nuts	Cotton	<i>Eleu-sine</i>	Grnd. Nuts
V. ...	N.C.	N.C.	731	498	—*	947	392	2,989	1,996
VI. ...	N.C.	1,740	510	399	1,606	1,825	643	1,786	1,215
I. ...	N.R.	2,425	549	419	919	1,616	1,056	1,545	N.Y.G.
II. ...	N.R.	1,180	—†	573	2,240	2,283	N.Y.G.	N.Y.G.	N.Y.G.
III. ...	180	2,205	1,130	565	1,934	2,047	N.Y.G.	N.Y.G.	N.Y.G.
IV. ...	711	2,120	1,181	1,269	1,899	2,006	N.Y.G.	N.Y.G.	N.Y.G.
MEAN ...	445	1,934	820	620	1,720	1,787	697	2,107	1,605

N.C. Not cropped, i.e. before the present rotation was started.

N.R. No Record, i.e. cropped on the present rotation but records not available.

N.Y.G. Not yet grown.

* Locusts.

† Failed.

Though absence of accurate records, climatic variations and minor changes in methods of growing crops over a period of fourteen years inevitably produce many inconsistencies in a set of figures such as those given in this table, they support the impression of all officers who have known this farm over this period that the general level of fertility has improved appreciably.

SERERE: FERTILITY EXPERIMENT

The experiment was started in 1936. The rotation used is a five-year one with different proportions of cultivation and grass fallow and different types of fallow treatment. Figures for the first and second circuits refer to ungrazed leys. Small dressings of farmyard manure have been used on some plots as mentioned later. As in the case of Ngetta Farm one section of the experiment is opened to cropping each year, so the effect of seasonal fluctuations are partially eliminated.

TABLE 2

SERERE: FERTILITY EXPERIMENT: MEAN CROP YIELDS

Yields in Pounds per Acre

Blocks	FIRST CIRCUIT			SECOND CIRCUIT			THIRD CIRCUIT		
	1st yr. Cotton	2nd yr. <i>Eleu- sine</i>	2nd yr. Cotton	1st yr. Cotton	2nd yr. <i>Eleu- sine</i>	2nd yr. Cotton	1st yr. Cotton	2nd yr. <i>Eleu- sine</i>	2nd yr. Cotton
I & II ...	371	663	614	349	1,642	421	539	1,132	...
III & IV ...	518	—*	—*	666	1,645	285	...	...	...
V & VI ...	359	878	270	543	1,403	486	...	...	...
VII & VIII ...	253	1,657	612	583	1,418	141	...	...	...
IX & X ...	540	1,804	382	563	1,646	247	...	...	...
MEAN ...	408	1,251	470	541	1,551	316	...	...	...

* Locusts.

Cotton ... Total seed cotton per acre.

Eleusine ... Dry unthreshed heads per acre.

The increase in yield of first year cotton from the first to the second circuit is partly to be attributed to more efficient prior opening of the land.

The drop in yield of second year cotton is partly accounted for by poor yields (141 and 247) in the second circuits of Blocks VII, VIII, IX and X in 1945-46 and 1946-47 when climatic conditions were abnormally adverse for late planted cotton.

The *eleusine* yields are a much better reflection of the general level of fertility of the land than cotton. The very low yields obtained on Blocks I, II, V and VI in the first circuit are almost certainly due to abnormal weather conditions, not low fertility. Figures should be considered in conjunction with those given in Table 4. The general inference to be drawn from them is that fertility has at least been maintained where a rotation containing an adequate period of rest under grass has been used.

SERERE FERTILITY EXPERIMENT

The first paper in this series, Kerkham (1), discussed evidence obtained in Uganda from experiments where fertility after grazing the grass resting period is compared with fertility after an ungrazed grass fallow. This paper discusses evidence obtained on the Serere Fertility Experiment.

The Experiment was designed by Dr. W. S. Martin and a description written up by Martin and Biggs (2). Numerous officers have assisted with layout and supervision including Dr. W. S. Martin, H. R. Hosking, A. L. Stephens, J. D. Jameson, J. M. Watson, R. G. Carr and the writers. Dr. Yates of Rothamstead has advised on statistical layout. In addition to officers mentioned above, P. E. Weatherley has assisted with statistical analysis in recent years. Various Directors of Agriculture and Provincial Agricultural Officers as well as other specialist officers of the Department have been consulted from time to time, and the experiment should be considered as a joint departmental project, and not as the work of any individual. Serere is situated in the south of Teso District of Uganda.

The area of which this farm is typical has a rainfall of just over 50 inches per year with two rainfall peaks; the early rains occur from March to May and are usually reliable, the second rains are expected in August and September but are less reliable. The soil has a very definite structure, and Martin (3) has found that this structure is rapidly lost under cultivation and regained under the grass fallow. The natural vegetation of the area is scattered tree grassland, consisting of low tree growth with high grass; *Combretum* and *Terminalia* species are the most typical trees and *Hyparrhenias*, particularly *Hyparrhenia rufa*, the most typical grass species.

TREATMENTS

The experiment contains three sets of treatments:—

(a) *Cropping Ratio*.—The whole experiment is cropped on a five-year rotation containing three ratios of cropping to fallow shift. These treatments are designed to find out how long it is desirable to leave land under a grass fallow. In this paper the number of years cropped is always cited first in the ratio. The ratios are:—

4:1, i.e. Four years under crops followed by one year fallow.

3:2, i.e. Three years cropped followed by two years fallow.

2:3, i.e. Two years cropped by three years fallow.

(b) *Cover during the fallow period*.—Treatments are:—

A. Natural Regeneration.

B. Planted Grass Fallow. *Cynodon* planted and allowed to compete with natural grasses.

C. Green Manure: slashed.

D. Planted grass fallow: slashed. *Cynodon* planted and slashed twice per year. This treatment was meant to simulate the effect of grazing. When the experiment was started grazing small plots was not considered feasible. In recent years plots under this treatment have been grazed instead of being slashed, but most of the results quoted in this article refer to the effect of slashing.

E. Green manure: dug in.

(c) *Manuring with farmyard manure*.—Manures are applied once in the five-year rotation at three rates:—

M.1 ... No manure.

M.2 ... $2\frac{1}{2}$ tons farmyard manure per acre.

M.3 ... 5 tons farmyard manure per acre.

LAYOUT OF THE EXPERIMENT

In order to eliminate the effect of seasonal variations two blocks, each containing one replicate of all treatments, are opened to cropping each year. Blocks I and II were opened in 1936, III and IV in 1937, V and VI in 1938, VII and VIII in 1939, IX and X in 1940 and then I and II again in 1941, etc. The first five-year rotation on each block is referred to

as the first "circuit", the second five years as the second circuit, etc. The rotations used on the experiment are:—

Year of Rotation			CROPPING RATIO		
			4 : 1	3 : 2	2 : 3
1st and 6th	...	...	Cotton	Cotton	Cotton
2nd and 7th	...	...	<i>Eleusine</i>	<i>Eleusine</i>	<i>Eleusine</i>
3rd and 8th	...	...	Cotton	Cotton	Cotton
			Groundnuts	Groundnuts	Rest
4th and 9th	...	...	Sweet potatoes	Sweet potatoes	
			Sorghum	Rest	Rest
5th and 10th	...	...	Cotton		
			Rest	Rest	Rest

The experiment contains 450 plots of approximately one-fortieth of an acre area. As a result of a carefully designed experimental layout it is possible to place reliance on comparatively small differences between treatment mean yields; in most cases differences of the order of 5% are statistically significant.

EXPERIMENTAL RESULTS: CROPPING RATIO

Mean yields of cotton in the first year of the Second circuit (6th year), *eleusine* millet in the first half of the second year in the Second circuit (7th year) and cotton in the second half of the second year in the Second circuit (7th year) are given in Tables 3, 4 and 5.

TABLE 3

EFFECT OF CROPPING RATIO: COTTON—5TH YEAR: TOTAL SEED COTTON IN LBS. PER ACRE

Blocks	I & II	III & IV	V & VI	VII & VIII	IX & X	MEAN
	1941-42	1942-43	1943-44	1944-45	1945-46	5 years
<i>Cropping Ratio</i> —						
4 : 1	345	681	525	563	608	545
3 : 2	332	672	532	596	521	530
2 : 3	371	646	572	591	561	549
<i>Significance</i> —						
Linear	None	None	None	None	None	
Quadratic					P=0.05	None

TABLE 4

EFFECT OF CROPPING RATIO: ELEUSINE—7TH YEAR
UNTHRESHED HEADS IN LBS. PER ACRE

	I & II	III & IV	V & VI	VII & VIII	IX & X	MEAN
	1942	1943	1944	1945	1946	5 years
<i>Cropping Ratio</i> —						
4 : 1	1,410	1,673	1,181	1,204	1,578	1,409
3 : 2	1,732	1,651	1,378	1,433	1,507	1,540
2 : 3	1,784	1,610	1,651	1,617	1,854	1,703
<i>Significance</i> —						
Linear	P=0.01	None	P=0.001	P=0.001	P=0.05	P=0.001
Quadratic	None		Nil	Nil	P=0.05	None

TABLE 5
EFFECT OF CROPPING RATIO: COTTON—7TH YEAR
Total Seed Cotton in lbs. per Acre

	I & II	III & IV	V & VI	VII & VIII	IX & X	MEAN
	1942-43	1943-44	1944-45	1945-46	1946-47	5 years
<i>Cropping Ratio</i> —						
4 : 1 ...	375	277	475	142	239	302
3 : 2 ...	438	283	481	138	246	317
2 : 3 ...	449	296	501	143	255	329
<i>Significance</i> —						
Linear ...	P=0.001	None	None	None	None	P=0.001
Quadratic ...	Nil	None	None	None	None	Nil

In Table 6 yields are given as percentages of the yield with a 4:1 Cropping Ratio.

TABLE 6
Yields as Percentage of 4:1 Cropping Ratio

Cropping Ratio	Cotton 6th year	<i>Eleusine</i> 7th year	Cotton 7th year
4 : 1 ...	100	100	100
3 : 2 ...	97	109	105
2 : 3 ...	101	121	109

The results given are the mean effects of cropping ratio.

Other factors which are included in this experiment are:—

- (i) Effect of farmyard manure.
- (ii) Effect of different covers when resting, including a comparison between grass and legume covers. Interactions between these various factors have not shown consistent high orders of significance. Should a three-year rest give a small response to manure whilst a one-year rest gives a large one, straight comparisons between the effect of cropping ratios would be masked by the manurial effect, and the Cropping Ratio $\times$ Manuring interaction would be significant. In fact this has not happened consistently and figures given in Tables 3, 4 and 5 are a fair reflection of the effect of treatments enumerated. The general inferences which can be drawn from these results are:—

(i) That cotton in the first year of cropping after the resting period (i.e. the 6th year of the experiment) does not show a significant reaction to cropping ratio.

(ii) Both *eleusine* and cotton in the 7th year of the rotation, i.e. second year after reopening from the grass rest, have given a marked, and highly significant, response to cropping ratio. The 3:2 ratio is significantly better than 4:1 and 2:3 significantly better than 3:2.

(iii) These results refer to yields in the second circuit of the rotation, i.e. when plots are being cropped for the second time having completed one cropping and one resting shift. One would expect differences between treatments to become more pronounced as cropping is continued and yields of cotton in 1947 from Blocks I and II agree with this expectation.

TABLE 7
Yields of Seed Cotton per Acre

BLOCKS I AND II			
	1st Circuit 1936-37	2nd Circuit 1941-42	3rd Circuit 1946-47
<i>Cropping Ratio</i>			
4 : 1 ...	—*	345	567
3 : 2 ...	—*	332	672
2 : 3 ...	—*	371	678
MEAN ...	371	349	639
<i>Significance—</i>			
Linear ...		Nil	P=0.05
Quadratic			P=0.05

* Treatments not yet applied.

COVER DURING THE RESTING PERIOD

In this experiment five covers during the resting period are compared:—

- A. ... Natural regeneration. In fact this has meant a more or less pure stand of *Imperata cylindrica*.
- B. ... *Cynodon*. Planted and then allowed to compete with natural grasses. Some *Cynodon* has persisted but the dominant constituent of the herbage has usually been *Imperata*.
- C. ... Green manure slashed. *Mucuna nivea* (Velvet bean) has been used. Plots are dug over and resown once per year during the fallow period. In most years the *mucuna* stand has been fairly good, though plots have occasionally been invaded by *Imperata*.
- D. ... *Cynodon* slashed. *Cynodon* persisted rather better in D than B, but *Imperata* was normally dominant. In the second circuit of the experiment slashing has been replaced by grazing, but results quoted refer to the effects of slashing.
- E. ... Green manure dug in. *Mucuna* used. Plots dug over and reseeded twice per year.

The mean effects of cover crops when land is reopened to cropping given in Table 8 are a fair reflection of treatments, as no interactions have been consistently significant.

TABLE 8
Yields in lbs. per Acre

Treatment	1st yr. Cotton	2nd yr. <i>Eleusine</i>	2nd yr. Cotton
A. Natural Regeneration ...	564	1,603	328
B. <i>Cynodon</i> ...	550	1,513	326
C. Green manure slashed ...	512	1,333	308
D. <i>Cynodon</i> slashed ...	545	1,634	326
E. <i>Mucuna</i> dug in ...	534	1,471	294
<i>Significance—</i>			
A+B+D—(C+E) ...	P=0.01	P=0.05	P=0.001
C—E ...	None	None	None
A—(B+D) ...	None	None	None
B—D ...	None	None	None

The three grass fallow treatments have produced higher crop yields when the land was reopened to cropping than the two green manure treatments. It should be noted, however, that this does not prove that a grass rest is more effective than a legume. Three considerations at least are involved.

(a) We have no reason to suppose that all legumes have equal fertility restoring properties. No careful comparisons between different legumes have been made so far in Uganda.

(b) We have positive evidence, that all grasses do not have similar fertility restoring properties.

(c) It is not possible to dissociate the effect of the green manure in this experiment and the effect of cultivation during the resting period. Soil in the three grass treatments (A, B and D) is undisturbed during the fallow. Soil in the C treatment is dug over once per year and in E treatment twice per year. Results so far can best be summarised as follows:—

(i) That the undisturbed fallow under perennial grasses is a better means of restoring fertility than *Mucuna* used as a green manure crop during this period.

(ii) that planting up land with *Cynodon* during the fallow period is no better than allowing the land to regenerate naturally under these conditions. Under these conditions is an essential part of this finding. Quite different results might be obtained on land which comes back to annual grasses, or had a full stand of *cynodon* been obtained each year, or had the fertility status of treatments been at a lower level.

EFFECT OF FARMYARD MANURE

The experiment contains comparisons between three different levels of manuring with farmyard manure:—

M.1 ... No manure.

M.2 ... $2\frac{1}{2}$ tons farmyard manure.

M.3 ... 5 tons farmyard manure.

Manure is applied once in each circuit of five years to the cotton crop taken in the second year, i.e. between *eleusine* and the second cotton crop.

The experiment has now been going on long enough to show how long the effects of manuring may be expected to persist under our conditions. Table 9 gives the mean yields obtained so far after manure has been applied.

TABLE 9
Yields in lbs. per Acre

Manurial Treatment	2ND YEAR		3RD YEAR		4TH YEAR		6TH YEAR	7TH YEAR		8TH YEAR
	Cotton		Groundnuts	Sweet Potatoes	Sorghum	Cotton	Cotton	<i>Eleusine</i>	Cotton	Groundnuts
No Manure ...	447		1,322	3,618	1,587	254	538	1,498	268	1,200
2½ tons farmyard manure	482		1,417	4,163	1,656	260	549	1,568	328	1,358
5 tons farmyard manure...	479		1,511	3,969	1,731	269	537	1,588	351	1,444
<i>Significance—</i>	P=0.01		P=0.001	Nil	P=0.01	Nil	Nil	P=0.05	P=0.001	P=0.001
Linear ...	P=0.05		Nil	Nil	Nil	Nil	Nil	Nil	P=0.01	Nil
Quadratic ...										

Cotton ... Total seed cotton per acre
Eleusine ... Dry unthreshed heads per acre
 Groundnuts ... Unshelled nuts per acre
 Sorghum ... Dry unthreshed heads per acre
 Sweet Potatoes ... Fresh roots per acre

Yields obtained in crops from 2nd year cotton to 7th year *eleusine* are a result of manures applied to the 2nd year cotton. The same manurial treatments were reapplied to the 7th year cotton. The inferences to be drawn from Table 9 are:—

(a) The benefits of applying manure are well marked in the year of application and in the two succeeding years, but appear to have practically disappeared four years after application.

(b) The response of cotton has, in general, been less well marked than that of *eleusine*, sorghum and groundnuts. In both the 2nd and 7th years the quadratic constituent of the response by cotton was significant as well as the linear, i.e. cotton under these conditions gives little more response to 5 tons of farmyard manure than it does to $2\frac{1}{2}$ tons per acre.

GENERAL SUMMARY OF FERTILITY EXPERIMENT RESULTS

In this paper the results of a comprehensive experiment carried out at Serere are discussed. The experiment has a carefully designed layout capable of detecting small differences between treatments. The main treatments are:—

(a) Three different cropping ratios within a five-course rotation, 4:1, 3:2 and 2:3.

(b) Grass rest during the fallow period compared with an annual green manure.

(c) Farmyard manure applied once in five years at the rates of 0, $2\frac{1}{2}$ and 5 tons per acre.

Results so far have shown (a) that yields are best with a low cropping ratio, i.e. long grass fallow period in comparison with the cropped period; (b) that a grass cover during the resting period is superior to an annual green manure and (c) that farmyard manure increases crop yields for about two years after application.

These results are very much what one would expect, but perhaps the most interesting feature of the results is the absence so far of any consistent interaction between the different treatments. One might have expected that farmyard manure would give its maximum benefit at a low fertility level, and would have more effect on some rotations than others. As yet there is no definite sign of any such differential response.

It is essential to bear in mind that the results obtained from this experiment have a direct application only to areas where soil, climate and farming systems are similar to those typified by Serere. In Buganda many of the soils are quite different, and differences in land values and population densities would make the application of experimental results to agricultural practice quite different from what it is in Teso, even were experimental results similar. Neither is there any light sandy soils of poor structure found in North-east Teso, East Acholi and in many other parts of East Africa.

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REPORT ON MINOR EXPERIMENTAL WORK

1. Coffee—Arabica

The observation plots at various centres in the Western Province suffered severely from *Antestia* attack and die-back and yields were negligible. Shade observation plots in the West Nile District also suffered from die-back despite the shade treatments which are combined with a ground mulch. Yield results were inconclusive. A comparison of *Nganda* coffee and Kent's *Arabica* under shade was abandoned owing to the disappointing growth of the coffee and fire damage, and apart from an indication that *Ficus* shade was preferable to banana shade no results were obtained from these plots.

2. Coffee—Robusta

Observation plots which are mulched and unshaded were maintained in the Northern Province.

Yields obtained from the Bulindi 1941 shade demonstration plot are as follows:—

Yields lbs. Fresh Cherry

	BANANA SHADE		<i>Ficus</i> SHADE		NO SHADE	
	Mulched	Un-mulched	Mulched	Un-mulched	Mulched	Un-mulched
Number of trees ...	15	20	38	34	54	50
Mean/tree—1947 ...	9·6	8·5	45·2	28·7	17·8	13·5
Mean totals per tree 1943-47 ...	20·0	14·7	72·2	51·2	37·8	30·8

After five crops the trees under *Ficus* shade are still increasing their annual yield to a greater extent than the trees under banana shade and without shade, the mulched plots in all cases yielding better than the unmulched. Over the years, *Ficus* shade has given a greater mean yield per tree than no shade and banana shade.

The Bukalasa shade and ground treatment experiment yielded at a considerably higher rate than in the previous season. Over twelve seasons, the yields of all treatments in fresh cherry are as follows:—

<i>Treatment</i>	<i>Cwts. per acre</i>
Shade	61.8
No shade	65.8
Clean weeding	69.9
Cover crop	64.1
Full mulch	57.9
Half mulch	65.3
Cotton seed	67.1
No cotton seed	60.5

Treatments are being reduced to shade and no shade, half mulch and clean weeding, with the intention of evening up soil differences so that untreated plots may be used for new manurial treatments at a future date.

The coffee shade observation plots on this station also yielded well. The *Robusta* plots required to be pruned heavily or stumped in the previous year and the yields of *Robusta* and *Nganda* are not therefore comparable.

Yields in lbs. of Fresh Cherry per Plot

<i>Treatment</i>	<i>Robusta</i>	<i>Nganda</i>
No shade	726	2,150
<i>Leucaena glauca</i>	255	3,106
<i>Ficus</i> spp.	536	2,443
<i>Acacia</i> spp.	1,091	2,320

3. Tobacco

(a) *Bulindi Farm*.—Stocks of air curing, flue curing and fire curing tobacco varieties were maintained and one acre of Nyasaland Heavy Western was grown for seed increase.

(b) *Kachwekano Farm*.—The variety, spacing and altitude trial of nicotine tobacco gave significant varietal differences. The variety Olsen 68 was superior to all others in yield of leaf and, despite its low nicotine content, was also superior in yield of nicotine per acre. Compared with the local variety now in production the comparative yields were:—

<i>Variety</i>	<i>Leaf per acre</i>	<i>Nicotine per acre</i>
	<i>lbs.</i>	<i>lbs.</i>
Olsen 68	2,020	90.1
Kigezi local	670	53.3

The mean yields per acre of all varieties at the different spacings and altitudes were as follows:—

Altitudes	Spacing	Leaf per acre	Nicotine
<i>ft.</i>		<i>lbs.</i>	%
6,500 ...	3' × 2'	1,280	6.24
6,500 ...	2' × 2'	1,156	5.11
7,500 ...	3' × 2'	956	6.87
7,500 ...	2' × 2'	1,128	6.24

Nicotine percentages at the wider spacings are significantly greater than those at the closer. Differences in yield of leaf due to spacing are not significant.

A spacing and altitude trial with the local variety of nicotine tobacco gave results indicating that an increase in altitude increases the percentage of nicotine in the leaf.

4. Oilseeds

(a) GROUNDNUTS

The Busoga sandwich trial comparisons of the variety B.227 and Local, gave similar results to those of last year. Yields were lower but B.227 maintained its advantage over Local with a mean yield of 969 lbs. of unshelled nuts per acre as against 881 lbs. Variety trials and observation plots were continued at numerous other centres. The Teso sowing date trials were invalidated by heavy mosaic damage and variable results were obtained which cannot be relied upon.

(b) LINSEED

Trial plots of Linseed varieties were grown in Toro District at three centres but at two centres, dry weather subsequent to planting resulted in partial crop failure and yields were low and unreliable. At the remaining centre, Kyembogo Farm, yields were:—

<i>Variety</i>	<i>lbs. per acre</i>
Red Wing I	1,168
Red Wing II 9032 ...	1,048
Royal II. W.369 ...	896
Royal II. 56:6997 ...	760
Liral Crown (Flax Variety) ...	592
Stormont Gossamer (Flax variety) ...	496

(c) SUNFLOWER

Yields of trial plots in the West Nile District were higher than those of last year and averaged 1,428 lbs. per acre. Similar plots in Karamoja District were disappointing and the mean yield was only 588 lbs. per acre. Plots of tall varieties in Ankole and Kigezi Districts gave yields reaching 1,000 lbs. per acre. As was the case last year bird damage was heavy. Dwarf varieties imported from England were also tried and the variety Pole Star gave the highest yield with 1,104 lbs. per acre with Jupiter a close second at 949 lbs. per acre. These dwarf varieties matured in three months against the four to five months of the tall varieties and in addition they were less prone to wind damage.

5. Beans and Peas

Trials of numerous varieties were continued and yields are summarised in the table accompanying this Report.

6. Fibre Crops

Trials of sunn hemp in Kigezi and Ankole Districts gave good yields of straw but fibre and tow production was disappointing in respect of both quantity and quality. Preliminary trials of *Urena lobata* were made at various centres. These were of an exploratory nature only to investigate sowing and cultural methods.

7. Cereals

(a) ELEUSINE MILLET

Variety trials were continued at numerous centres and at Kakumiro Farm a comparison of the local practice of not weeding this crop against the generally accepted practice of clean weeding was made. Results showed a decrease in crop with the former practice varying from 12 per cent. to 68 per cent.

(b) RICE

Trial plots in Mbale and Busoga Districts partially failed through excessive flooding. Plots of rice at Lalle in Teso District also experienced difficulties in the control of flood water. Results were inconclusive but there were indications that satisfactory yields could be obtained from sowings made during any month between March and October and that the variety Afaa yielded better than Sindano. One plot in the Agu swamp which received adequate water throughout the growing period, gave a yield of 2,828 lbs. of paddy per acre.

(c) WHEAT, OATS AND BARLEY

Trials of varieties of these cereals were conducted at Kachwekano Farm in Kigezi District and the mean yields obtained were:—

Cereal	Variety	Grain per acre
Wheat ...	Kenya Governor	lbs. 612
	No. 117 A.	306
Barley ...	Prior	1,530
	Maltworthy	1,972
Oats ...	...	1,462

8. Root Crops

(a) CASSAVA

The increase of mosaic resistant varieties continued at all available centres for ultimate distribution to growers. Palatability and keeping tests on numerous varieties of cassava at Kakumiro farm gave interesting information on the length of time these varieties can be kept in the ground without deterioration. These trials are now in their fourth year.

(b) SWEET POTATOES (IPOMOEA)

Comparisons of ridging *versus* normal cultivation of this crop were continued and there were indications of inter-varietal reactions.

(c) ENGLISH POTATOES (SOLANUM)

Observation plots of several varieties were planted at Kyembogo and Kachwekano farms and at the former farm, yields were good and often exceeded 12 tons per acre.

9. Fertility Investigations

(a) KACHWEKANO FARM

An investigation into the effect of various systems of land use on this typical Kigezi soil is being conducted. The treatments cover use of land for cultivation or pasture and both combined. A standard rotation is followed on all cultivated plots except in one case where a destruction rotation of constant cropping under maize is used. The treatments are:—

1. No cultivation: natural cover slashed and grazed.
2. No cultivation: natural cover untreated.
3. Four years' cultivation and two years' ley grazed.
4. Four years' cultivation and two years' ley not grazed.
5. Continuous cultivation with an application of Kraal manure at the rate of 10 tons per acre every second year.
6. Continuous cultivation: no manuring.
7. Continuous cultivation with maize: no manuring.

This is a long term investigation which while not expected to give precise results should provide useful information on the resistance of the local soils to attacks on their structure and fertility.

(b) KAKUMIRO FARM

A soil exhaustion plot was started on which continuous cropping will be effected as a demonstration of the evils resulting from overcropping of land.

(c) BUKALASA

(i) *Methods of Cropping Observation Plots—Block G.*—Cropping continued according to plan, maize followed by cotton being the crops taken. Yields were:—

Strip No.	Method of Cropping	LBS. PER ACRE	
		Maize	Cotton
1	Continuous cultivation ...	1,716	438
2	Continuous cultivation + F.Y.M. ...	2,244	372
3	3 years' cropping: 3 years' rest + F.Y.M. ...	1,848	332
4	3 year's cropping: 3 years' rest ...	3,380	552
5	3 years' rest grazed: 3 years' cropping ...	2,412	526

Strips 1 and 2 are now in their sixth year of cropping and the soil is noticeably showing a run-down condition. It is suspected, however, that this may not be due entirely to its treatment but that its inherent fertility may be lower than on the other strips.

(ii) *Continuous Cultivation Observation Plots—Block E.*—The sub-plots which had been under the short term regeneration treatments described in last year's report were brought back into cultivation. At the time of opening the stand of *Chloris gayana* was excellent while that of Kavirondo Sorghum was good. The *Setaria italica* had died out and the natural regeneration plot was growing some couch grass, *Digitaria scalarum*, and a little elephant grass. Laboratory examination of the soils of these "regenerated" plots showed no improvement in soil structure but cropped with cotton, yields were higher on the *Chloris* and sorghum plots than those obtained from the plots which had not undergone the regeneration treatments.

(iii) *Holdings C and D.*—The farming systems of these holdings were maintained. The recorded costings arranged over three years have shown that opening up land from a grazed elephant grass ley costs considerably less than opening from a ley on which the elephant grass has been cut for stall-fed forage. The comparative figures are 125 man days for the former system and 234 man days for the latter. The reason would appear to be that the elephant grass is partly grazed out, while on the ungrazed land, a heavy stand of elephant grass is maintained over the whole period of the ley. The incidence of lumbugu also appears to be less on the grazed land, which is surprising and is not in accordance with experience at Kawanda.

TRIAL PLOTS—CROP YIELDS

TABLE I

Pounds per Acre

Trial Centre	PEAS					
	Dutch Marrowfat		Alderman		Harrison's Glory	
	Spring	Autumn	Spring	Autumn	Spring	Autumn
Kyembogo ...	623	1,924	581	1,851	871	1,706
Kachwekano ...	927	1,980	715	1,920	689	2,100
Means ...	755	1,952	648	1,885	780	1,900

Trial Centre				BEANS		
				Canadian Wonder	Local	Abundance Runner
Bulindi ...	...	...	...	812	609	1,479
Kyembogo ...	...	...	...	1,125	1,125	1,307
Kachwekano ...	...	...	...	201	1,865	1,264
Means ...	...	...	...	713	1,199	1,350

Trial Centre				SOYA BEANS			
				Variety	Spring	Autumn	Means
Kyembogo ...	...	...	...	No.			
				63	1,089	2,047	1,568
				68	1,067	1,481	1,274
				184	1,024	1,350	1,187
				67	1,220	2,091	1,665
				69	1,045	1,786	1,415

Trial Centre				GROUNDNUTS*			
				Atuboi	Local	B.239	B.227
Ibanda ...	...	...	...	2,091	2,027	2,245	2,071
Kibingo ...	...	...	...	1,351	1,460	1,155	1,024
Gayaza ...	...	...	...	584	527	545	564
Lwashamaire ...	...	...	...	2,289	2,027	1,896	1,853
Bulindi ...	...	...	...	1,885	2,001	2,088	2,189
Means ...	...	...	...	1,641	1,608	1,586	1,540

* Unshelled nuts